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I.—*Notes on the Duty of Government in periods of Famine.—By* JOHN F. THOMAS, ESQ. *Madras Civil Service.*

(Continued from the last Number page 78).

This enquiry,* which on a more extended examination of the subject I would confine to famine alone, is one at all times of such extreme importance to the people, and has acquired so much additional interest from the present circumstances of part of the Northern Circars, that I am induced to prosecute it more at length. I am anxious also to avoid a misconstruction to which the former remarks† are, I fear, liable; that because I am disposed to question in the present state of Southern India the reasoning, and the principle of the circular order of 1833, deprecating any interference on the part of Government; I would therefore advocate an opposite course; and recommend a constant and general tampering with the grain trade of the country. This is far from my intention. The sole question I would raise, is the propriety of Government interference at periods of great exigency,—at those times only, when the drought has been general over large tracts of country, and there has been a failure of the standard crops throughout a whole province—when, in fact, we have either cause

* See former brief observations No. XXII. p. 78, viz. "Whether there are not, as Dr. Smith seems from his guarded language to admit, means open to the Government, which may not be improper for it to adopt in periods of drought, by which that most dreadful scourge, the absolute famines which now periodically desolate our provinces, may be wholly prevented, and scarcity at all times greatly mitigated, without a departure from sound general principles, and at no great charge on the finances of the State."

† See No. XXII. pp. 71-72.

to dread, or are experiencing famine with all its fearful destruction of life and property; such as has been witnessed in our provinces in 1807, in 1823-24, and recently in 1832. I need scarcely add, that it is further still from my views, to propose any measures for fixing, or regulating the price of grain, or similar arbitrary interference with the freedom of the grain merchant. Such measures, there can be no doubt must be injurious, by impeding the traffic in grain generally; but above all, by preventing that frugal use of the stock in hand, without which it would be impossible for the people, at periods even of partial scarcity, to escape all the horrors of famine.

In entering upon this investigation it is of great moment, that the real practical question for examination should be distinctly brought before us, it appears to me that it may be fairly stated in these terms. Is it the duty of the Government in periods of drought, to look on as at present, almost passively, whilst thousands and tens of thousands of the population are swept off in a few months: or, are there now safe, and legitimate means of interference within its power, through which it can secure much larger supplies of food for the people, than they could otherwise obtain, and thereby lessen the mortality of famine? It is only when the question is put in this form, and we keep in view, the enormous waste of life and of national wealth in this country in seasons of severe drought, that the subject is placed in its true light.

During the drought in Guntoor in 1832 there are grounds to conclude, that more than one third of the inhabitants of the district, or upwards of 200,000 persons perished, in a population of little more than 500,000, within a short period. The returns of population in the year prior to the famine, give 512,000, in the year subsequent, but one half or 255,000, and four years later, but 267,000, and it is asserted that there was little or no emigration. Previous famines have also been estimated to have destroyed one third of the inhabitants of those districts, in which drought was general. And we might perhaps fairly assume this proportion, as the ratio of mortality in famines in India, when they are left to work out their natural effects unchecked. In examining therefore the present system of non-interference, under which the people depend solely on private enterprize for additions to their stock of food, the loss of life throughout the whole population must be calculated at this rate; and we might probably also safely estimate the loss of the labourers of a

Population of Guntoor.

Fusly....1241	512,517
1242	255,511
1244	267,714

province, including men and women, at a higher average, for it is upon this class, that famine presses with such peculiar severity.

If this ratio, either of loss of life or of labour be considered too high, one much lower may be assumed, and the magnitude of the evil will still be readily admitted; and it will also I believe be admitted, that if the Government could afford relief without serious detriment to any class of society, and without involving its finances in inextricable difficulties, it would be both its duty, and its interest to give this relief.

This brings us immediately to the consideration of the arguments of Dr. Smith, and other great authorities, which go to shew, that a Government has no power to afford relief in such emergencies,—that its interference must do harm, and further,—that its interposition is uncalled for, as all available aid will best be rendered by the operation of self-interest, inducing the private trader to throw in additional supplies of food for his own profit :—and that non-interference is consequently the only sound policy of a state.

The validity of this doctrine in the circumstances of Europe, may be readily granted. Nor do I see, that Dr. Smith's arguments can be shaken on a single point, when applied to countries like Great Britain in an advanced stage of society, and situated within the temperate zones: which are never visited by absolute famine, as the effect of the season alone, but only by scarcity. But I hesitate, without further and more full investigation, to acknowledge its truth in respect to South India; for much of the reasoning of Smith appears to me inapplicable to this, or to any tropical country in an early stage of civilization. Where, the people are dependent for their food, almost wholly on the periodical rains, and where, as our experience has demonstrated, it is not merely scarcity with which we have to deal, but absolute famine extending at the same moment over immense tracts; and where we must add also,—the resources of the inhabitants are almost as nothing, compared with the resources and means of the inhabitants of Great Britain, or highly civilized European states.

But to proceed to the examination of Dr. Smith's views in detail. On analyzing them, his doctrine of total non-interference with the provisioning of the people, appears to be based chiefly on these grounds. First, that a famine is never the effect of a bad season *alone*, for that occasions only scarcity. Secondly, that it cannot be caused by unjust combinations on the part of the dealers in grain, for their interest is the same with the people. And thirdly, that there are, from facility of inter-communication and other circumstances, resources in Europe available

to the people, which, combined with a frugal consumption, effectually secure them against famine, if there is no interference with the corn trade by the Government.

He first remarks, that though a real scarcity is ordinarily occasioned by the fault of the season alone, a famine is *never* so occasioned; or to give his own words. "Whoever examines, with attention, the history "of the dearths and famines, which have afflicted any part of Europe "during either the course of the present or that of the two preceding cen-"turies, of several of which we have pretty exact accounts, will find, I "believe, that a dearth never has arisen from any combination among the "inland dealers in corn, nor from any other cause, but a real scarcity, "occasioned sometimes, perhaps, and in some particular places, by the "waste of war, but in by far the greatest number of cases by the fault of "the seasons, *and that a famine has never arisen from any other cause, but* "*the violence of Government attempting, by improper means, to remedy the* "*inconveniences of a dearth.*" And he adds, that "the scantiest crop, if "managed with frugality and economy will maintain through the year, "the same number of people that are commonly fed in a more affluent "manner by one of moderate plenty."* It is deserving of notice that throughout, Dr. Smith speaks only of the "inconveniences" of dearth; and never once contemplates apparently, a people in the fearful state of destitution, to which a season of general drought now reduces the population of this country: when if allowed to run its course, famine cuts off one third of the inhabitants, with the great mass of their cattle. For drought in the tropics, does not as drought or excessive wet in Europe, affect only the standard crops of the country; but it is in the expressive language of scripture, "a drought upon the land, and upon the moun-"tains, upon that which the ground bringeth forth, and upon men, and "upon cattle, and upon all the labour of the hands." This utter destruction of all the resources of the people, I apprehend to be the

* "In an extensive corn country between all the different parts of which there is a "free commerce and communication, the scarcity occasioned by the most unfavourable "seasons can never be so great as to produce a famine; and the scantiest crop, if "managed with frugality and economy, will maintain, through the year, the same number "of people, that are commonly fed in a more affluent manner by one of moderate plenty. "The seasons most unfavourable to the crop are those of excessive drought or excessive "rain. But as corn grows equally upon high and low lands, upon grounds that are "disposed to be too wet, and upon those that are disposed to be too dry, either the "drought or the rain, which is hurtful to one part of the country, is favourable to ano-"ther, and though, both in the wet and in the dry season, the crop is good deal less than "in one more properly tempered, yet, in both, what is lost in one part of the country is "in some measure compensated by what is gained in the other."—*Wealth of Nations Book IV chap. V. Digression concerning the corn trade and corn laws.*

true character of Indian droughts;* and I believe it also to be certain, that they do, without any adventitious cause save what may be found in the existing condition of society, of themselves constantly occasion the most desolating famines. If this be denied, and it is contended, as Dr. Smith is disposed, though with some hesitation to contend, that the droughts of India are not so intense, nor so universal as of *themselves* to occasion famine—I would ask, how has it then occurred, that tens and even hundreds of thousands have perished by actual starvation under British rule, whilst it is certain, that there has been no tampering on the part of Government with the grain trade of the country, and the people have been left to the freest use of their own resources. In opposition to Dr. Smith's supposition "that the drought is scarce ever so universal as necessary to occasion a famine if the Government would allow a free trade." I should maintain, that no fact is now perhaps better established in Indian statistics,—that not scarcity, but absolute famine in all its severity, is caused by the fault of *the season alone*, and that it is not brought on by any improper regulations on the part of the Government.†

Should this be conceded, it appears to me to strike at the root of the doctrine of non-interference in tropical countries, and consequently that we are not warranted in applying, as the circular order of Government does, Dr. Smith's principle without limitation to Southern India: but must confine its application to cases, similar in their character to scarcities in Europe. To seasons for example of very partial drought or of dearth, where, either from the previous stores of grain in the pits of

* The difference between the bad season of the tropical and the temperate zone, is strongly marked in the following report of the out turn of the late bad season in 1838 in Great Britain and Ireland.—*Results of the Harvest in Ireland.* In this country the harvest is at an end, with the exception of isolated mountain districts. The result may be thus shortly stated. Wheat is generally speaking, fully one-third short of an average crop, and the grain is deficient in yield. As far as the farmer is concerned, the price will, to some extent, make up for what is wanting in quality and quantity. But the superabundance of the oat crop is admitted in all quarters and barley and potatoes are, with very few exceptions, also beyond an average crop. In fact, allowing for the partial failure of wheat, this year will be one of the best the Irish farmers have had for a long time. We are much better off than our neighbours either in England or Scotland.—*Dublin Post, Tuesday week.*

† "In rice countries, where the crop not only requires a very moist soil, but where, "in a certain period of its growing, it must be laid under water, the effects of a "drought are much more dismal. Even in such countries, however, the drought is "perhaps, scarce ever so universal as necessarily to occasion a famine, if the Government "would allow a free trade. The drought in Bengal, a few years ago, might probably "have occasioned a very great *dearth.* Some improper regulation, some injudicious "restraints imposed by the servants of the East India Company upon the rice trade, "contributed, perhaps, to *turn that dearth* into a famine."—*Wealth of Nations Book IV chap. V. Digression concerning the corn trade and corn laws.*

the ryots, or from the limited area over which the drought extends (as it is probable is the case at present in the Northern Circars). The means of alleviation, and of staying off famine are accessible to the great bulk of the population.

That Dr. Smith's doctrine can only be justly applied to such cases, will I think be further evident, upon consideration of the arguments advanced in its support by himself and Dr. Chalmers, who has followed out his views at length,* both laying much stress, upon the natural alleviations, or the palliatives to scarcity, at all times within the reach of the people of Europe.

They observe, that the variety of soil and climate greatly modifies the effect of bad seasons, that there are substitutes for the food of man in the grain raised for cattle, (and we might add a certainty in the temperate zone of a supply of water for animal life), that the large amount of the external commerce of the different states of Europe, gives to each a command at all times over the products of the other, and that these, with other alleviating circumstances, amply secure the inhabitant of Europe against absolute famine or starvation. So effective indeed are these palliatives in Europe immediately within the reach of the people, and so dissimilar is European dearth, from Indian or tropical famine; that whilst we number deaths by tens of thousands in a few months, Dr. Chalmers hesitates not to affirm (see his late Bridgewater Treatise. " On the moral and intellectual constitution of man" vol. II. p. 46) " that the country emerges from the visitation of dearth, *without " in all probability, the starvation of one individual.*" And again at p. 49. " It is in these various, ways that a country is found to survive so " well its hardest and heaviest visitation, and even under a triple price " for the first articles of subsistence, it has been found to emerge into " prosperity again, without an authentic instance of starvation throughout " all its families." These passages must I think carry conviction of a truth, which I am anxious to establish, of the first importance in this enquiry—that there is nothing parallel in the case under the review of Smith, Chalmers, and other political economists of Europe, to the circumstances before us in India: and I would rest my first objection to the unlimited application of the principle of non-interference in periods of famine in South India, on the manifest dissimilarity between the circumstances of dearth in the two countries.

Should this objection be considered of any weight, we may then be permitted to question, whether the authority of Adam Smith's great name, can properly be thrown into the scale in favour of the doctrine of non-interference, in the peculiar exigency of famine by the fault of the

* See Dr. Chalmers' Political Economy, and his late Bridgewater Treatise.

season alone. And it may also then be open to discussion, whether the general principles of his work lead us to conclude, that it is the duty of a Government at periods of excessive drought, rigidly to abstain from all attempts to increase the quantity of food in the country, or whether it may not by a judicious application of its means, secure enlarged supplies, and lessen the mortality; and the consequent destruction of labour and of capital.

Certain it is, that Malthus* and other writers, who have ranked high as followers of Smith, have maintained, that the provisioning of the country cannot always be safely relinquished to the operation of the ordinary laws of supply and demand, which govern less necessary articles; and that there are considerations affecting the food of a people, which may take it out of the ordinary rules of Political Economy. The case of South India during famine, is, I am disposed to think precisely, one of these cases, requiring therefore to be dealt with under peculiar regulations. And as it is no argument against the corn laws of England, that there is always a compensation for the produce lost by a bad season in our own country, in the abundant crops reaped by our neighbours—unless we are at the same time assured, that that abundance will not be withheld from British ports, from hostile motives or commercial jealousy. So in like manner, it is no argument in favour of non-interference in this country, to urge, that the grain lost by the failure of the monsoon in some one of our provinces, is, in the merciful dispensations of God, invariably compensated by the superabundant crops of other kingdoms, or provinces. Unless it can also at the same time be clearly proved to us, that this excess of produce of the favoured province, will flow into those suffering from drought; and *that, in time* to prevent the destruction of the inhabitants, and with them the very sources of national prosperity. Unless this can be shewn, this peculiar dispensation of God's providence, by which the deficiency of one portion of the world might be supplied from the superabundance of another, is utterly unavailable, for it amounts to nothing to tell us that such extra supply does exist elsewhere, it might as well not exist, if we have not at the same time the assurance, that it will reach those who must perish without it.

We come now to the consideration of another of Dr. Smith's main averments, that this abundance of favoured districts will readily find its way into famine districts, if Government do not interfere. In establishing this

* See Tracts on the Corn Laws.

point he first ably disposes of the objection which might be made to his views, *in limine*, that famine or excessive dearth may be caused by a combination of the dealers to raise the price of corn at the cost of the people. This he shews to be impracticable, and proves that there is an identity of interest between the corn dealer and the consumer, which precludes injurious combination. His argument on this head, I believe to be in a great degree applicable to this country. At the same time it is quite possible under the peculiar circumstances of South India, that cases have occurred, and may again arise, in which the wholesale dealers and importers in our provinces, who are not in danger as in Europe of having their trade encroached upon, have combined to prevent additional supplies of grain being introduced; or, what amounts to the same thing, have remained inactive, with the view of enhancing the value of the stock in hand. But such cases must I should think be very rare, as in general, it is decidedly the interest of the dealers to bring in as large supplies as practicable, and obtain the high prices of scarcity.

But it is not upon this part of Dr. Smith's reasoning that I would remark. It may be readily granted that it is the interest of the dealer to supply the people in times of famine with food, as plentifully as he possibly can; but it is his power,—his ability to do so effectually, in the present condition of this country, that I question.

Dr. Smith assigns the facility of intercommunication between the different provinces of a state, and different countries, as one prominent ground of his opinion, that when a Government does not improperly interfere, the supply of grain will be ample and sufficient to prevent famine. And when the nations of Europe are at peace, and there is nothing to prevent her merchants from a free intercourse with every state, it is no doubt true, that the wants of one kingdom or province in periods of scarcity, will be immediately provided from the stores of others, by the ordinary motives and exertions of self-interest. But I hesitate to make a similar admission in the case of this country, for we must first ask, does this facility of intercommunication now exist in Southern India? And are not the defects and imperfections in the means of communication between the several provinces of this Presidency, and also distant markets, such, as to raise a barrier, which the private merchant cannot now overcome, to the *timely* importation of those large supplies of grain required in districts visited by severe drought. And may it not perhaps be fairly questionable, whether the just inference from Smith's reasoning under these circumstances, is not, that the Government of a half civilized country, of which this defect of intercommunication is the common feature, should

abstain from interference in the emergency of famine; but whether it should not for the time, come forward and afford such aid, as may place her grain merchants in the period of severe drought, as much as possible on a level in the means of communication, with the dealers in more advanced nations, by undertaking part of the labour, and bearing part of the charge of transit.* But whether this be a legitimate inference, or not, it is I think clear, that till there is that facility of intercommunication which Dr. Smith assumes, neither his principle, nor his reasoning can be justly applied to this country.

There can also I think be little doubt, that in laying down his great doctrine of non-interference, Dr. Smith had under consideration, the abundance of capital in private hands, the extensive credit, and the known enterprize, and spirit of adventure in British and European merchants; as well as the intimate connection of the whole mercantile body of Europe; by which, the merchants of London, Liverpool, or Dantzic can obtain with ease, an immediate consignment of corn from each other, or from any quarter, at the shortest notice.† Whilst the large and constant commerce by sea, and the good roads generally throughout European states, remove all impediments to an early augmentation of the food of the country, even from distant markets, whenever scarcity prices shall make this profitable. All these circumstances are, I apprehend, included as the grounds of Dr. Smith's views; and I cannot but think, they differ widely from the actual circumstances of this Presidency. Not only, are the means of intercommunication by land between our provinces very defective; but it must also be allowed, that the maritime commerce of the Presidency is in its infancy;—that the whole

* As an illustration I would propose the question, whether in the event of absolute famine in our provinces bordering on the Punjab, it would be an injudicious interference on the part of Government, at a moment of pressing exigency to offer the native merchant of Bengal and Bombay, the use of the Government steam vessels on the Indus and the Ganges at a low charge, and thus give him the means of introducing supplies in one-fifth of the ordinary time. And whether this increased facility of importation at such a period, and thus raising the country *pro tempore* to a level with more civilized states in the means of intercommunication, would not rather be in accordance with, than a departure from Smith's principles; if care were at the same time taken by bounties, that no merchant should suffer loss by his more tardy importations. Or, to apply the case to the Madras Presidency, would it be an improper act, if the Government were to offer the native merchant at periods of famine, the use of vessels to bring up his grain against the monsoon, when the native craft either could not, or would not move.

† The extensive credit which the European merchant enjoys, is the consequence of the general integrity of the class; and this integrity, not only gives him a command over the capital of others, but secures a faithful execution of his orders in foreign markets. It is, I have reason to believe, the difficulty the European capitalist in this country finds, in obtaining through native agency a similar upright and faithful execution of orders, and supplies of grain of good quality, which keeps him from embarking in the trade, even when large profits are to be made in it.

mercantile body is small, in proportion to the mass of the population, and its capital and credit limited: and that these causes, whatever may be the strength of the motives of self-interest, by which the dealers are prompted, must tend greatly to obstruct, if not to prevent the success of any effort, they may make to supply the urgent, and vast demand of districts visited by famine.

As already observed, the actual fact is, that they do not now in any measure meet this demand, even when supplies have been obtainable with comparative ease; and that grain has not hitherto been introduced by the private merchant in seasons of famine into districts, in time to prevent the starvation of the population. The single fact, *the great mortality of the labouring classes which now takes place in every season of general drought,* appears to me fully to demonstrate of itself, the total inefficacy of private exertion in the present state of South Indian commerce. But to place this point beyond dispute, I annex a table of the prices of grain at Ganjam, Vizagapatam, and the neighbouring provinces throughout the entire period of the late famine in Guntoor. It will be seen from this table, that in the year 1832, whilst tens of thousands were perishing in Guntoor from the want of food and consequent disease, and grain was there more than triple its ordinary price, it was to be had at near markets, with which there was moreover an open sea-communication, at the ordinary rate, or at one-third of the price; and that throughout the whole period of the famine, private enterprize never brought in enough, either to lower the prices considerably in Guntoor, or to raise them much in Ganjam and Vizagapatam. So manifest is it, that the abundance of one district in South India is not now made, through the instrumentality of private exertions, to supply the deficiency of another.

	Guntoor.		*Ganjam.*		*Vizagapatam.*		*Rajamundry.*		*Masulipatam.*	
	Rice	Raggy	Rice	Raggy	Rice	Raggy	Rice	Raggy	Rice	Raggy
Fusly 1231 AD. 1831-2	154	197	50	71	47	60	57	65	59	75
Fusly 1232 AD. 1832-3	200	218	61	87	69	90	102	141	123	184*

If it were possible to obtain them correctly, it would be desirable to add to these facts, data which might shew the limited amount of capital in the hands of the grain merchants, and the low state of trade

* The prices are given for these two important grains for the entire period of the famine, but it is necessary to observe, that Masulipatam also suffered partially from the same drought which afflicted Guntoor, and the high price there, is probably to be accounted for by that circumstance, and not by the supplies, withdrawn for the use of Guntoor.

in general, and from them also to prove the inability of the dealers to meet the extraordinarily large demand of famine. But on these points I must refer to the remarks made in the former part of these notes ;* and I would ground my second and further objection to the application of Dr. Smith's doctrine to this country, upon the facts just adduced. They appear to me to establish this important point.—That how great soever may be the incentive of self-interest, and the intelligence of the mercantile body of this Presidency, there is not now practically, that intercommunication between our provinces or distant markets, which would enable the private dealer (as Dr. Smith assumes) readily to meet the wants of a district suffering from bad seasons; and that if left to private exertion, the country must experience all the horrors of famine every season of general drought. And such accordingly was the case in 1824, when hundreds and thousands perished at Madras and its neighbourhood, although it was then confidently predicted by the first authorities, that if left to himself, the private merchant would bring in ample supplies.

Though I do not think any thing further is required to establish the inadequacy of private effort to meet the exigency of famine, there is a consideration, applicable chiefly to the rural districts of the Presidency, which it may be well to bring under review. In such districts, a difficulty, wholly unknown in Europe, to the timely and adequate supply of food in seasons of famine, arises it is probable from the peculiar condition at this date of South Indian society. Nine-tenths and more of the population of those districts are agricultural, or subsist directly from the land; and a large proportion depends for entire support on the out-turn of the year. The agricultural labourers, the great bulk of the population, do not, as in Europe, receive their wages in money, and obtain their supplies of food from the baker, who has capital embarked in the grain trade, and who procures his corn from a distance or near, as may best suit his interest; but they are paid their *wages in kind*, when the harvest is gathered in, and on that they must subsist through the year. If the harvest fails, whence are their wants to be supplied? It is not, I conceive, in the nature of things, that the petty village grain merchant, whose ordinary traffic is confined to the supply of a few families, by purchases made on the spot, should have a stock in hand to meet the large extra demand of the labouring class, which he could give to them on credit. And even the substantial ryot, when he has no store left from the crops of former years, cannot I should suppose venture to give any aid at such a crisis—so that it may be doubted, unless supplies of grain are introduced by foreign agency, and

* No. XXII, p. 74.

brought to the door of the village chitty, if there is capital, or agency in the district, wherewith the demand of the labouring classes for food, can at such seasons be met. In a society differently constituted, like that of Great Britain, where more than one half of the population are non-agricultural, the labourers, both manufacturing and agricultural can fall back upon their employers; and wherever there is a large manufacturing and commercial class, there also, is a large grain trade, and a body of dealers accustomed to import supplies, who in time of high prices will greatly enlarge their transactions, and the increased demand of the people for *foreign grain* can be met without difficulty. But in the circumstances of the rural districts of this Presidency, I see no means of meeting a like demand; and hence there may be a necessity for Government interference whilst society is in its present condition.

Independently of the several considerations which have been already advanced, I would also remark that it appears necessary to the establishment of Dr. Smith's great principle of non-interference, that all the circumstances to which he adverts should exist combinedly. It is not enough for example, that it is physically true in any country, that scarcity only, and not famine is caused by a bad season; but it must also be established, that there is a total abstinence in that country at the same time from unjust combination by the dealers in corn. For if an unjust combination does exist, then I conclude, the Government must and ought to interfere, for its interference can alone prevent the starvation of the people, even in a period of scarcity. Again, let there be no unjust combination, yet if a facility of intercommunication does not co-exist simultaneously with perfect freedom of trade, and all barriers to the ready transfer of the grain of one province, or one market to another, are not removed; the Government may even in that case, be called upon to interpose, in order effectually to secure the timely introduction of the necessary supplies of food. So that in applying Dr. Smith's principle, we must not look only to specific points; but enquire, whether the circumstances of a country are the same, or very similar *in all points* to those he had under review, before we can recognize the validity of his principle. If the facts in South India are, that in a bad season, instead of scarcity, we have famine, and in lieu of an immense body of traders, too numerous to combine, with abundant capital, and intelligence equal to the greatest enterprizes, we have but comparatively a small body, who can combine, of limited credit and capital, and not ordinarily engaged in distant speculations. And if instead of a facility of intercommunication between the different provinces, and distant marts, there are great impediments existing, not to be readily surmounted by

private effort: then, not only if all these circumstances, but if any one exists, we have not, I am disposed to think, a foundation upon which Dr. Smith's doctrine can be safely erected, and we must question its applicability to this country.

But whilst this, with much of what has been advanced, may be admitted, yet the inference which would follow, that Government interference is called for, may not be conceded; for it will perhaps still be argued, that private exertion, if wholly unfettered, will be found the safest and *best* means of supplying, *even* the greatest and most urgent wants of the people. Or to use Dr. Smith's language "that the natural effort of every individual to better his own condition, when suffered to exert itself with freedom and security, is so powerful a principle, that it is alone, and without any assistance capable of carrying on a society to wealth and prosperity, and of surmounting a hundred obstructions with which the folly of human laws too often encumbers its operations." Book IV. chap. V. Digression, &c. There is so much force in this statement, that if the fact did not stare us in the face, that these natural efforts do not in any adequate measure now meet the case of famine in this Presidency, I should not venture to advocate even the most cautious Government interference; although I think it demonstrable that the reasoning by which the doctrine of non-interference has been hitherto supported, is, so far as South India is concerned, untenable. But so long as famine in this Presidency occasions any thing like the present fearful mortality, and destruction of property, and so long as entire provinces are desolated by a single season of severe drought; it appears almost a moral duty, before we rest satisfied with the present passive system, to institute the fullest enquiry, whether there are not at the command of the Government legitimate means of adding to the food of the country, and thereby lessening the misery and ruin of such periods. I would therefore ask, whether there are solid objections on general principles, to the Government, in the exigency of famine, throwing additional supplies into the market by the instrumentality of the grain merchants themselves, by offering them facilities for their commerce, not accessible to them at other times. In advances of Government capital,—in increased means of transit,—in premiums on importation in the form of bounties, or of return cargoes of Government salt; or similar public aid, which would not tend to supersede, but to stimulate their exertions. Nor am I prepared to allow, that—if the Government went a step further, and imported supplies of foreign grain at its own risk, *not to be brought into the market for sale to compete with* the grain merchant, but to be dealt out as rations to the people driven by extreme poverty to work on the roads,

or other public works—an interference with the provisioning of the people to this extent would be faulty in principle. For this class, it must be remembered, has no means of obtaining food from private sources in exchange for their labour, nor could they without Government aid, become at such times purchasers from the grain merchants. The payment for their labour in kind by rations, could not therefore trench unjustly upon the interests of the dealers, nor lessen the efficiency of the grain trade. And till some experiment of this character has been made, and failed, are we fairly in a position to carry out Dr. Smith's great principle of total non-interference, as the only sound policy of the state, at the sacrifice now periodically made of an enormous waste of life and of national wealth?

And, lastly, even if it shall be found upon the most ample examination, and after judicious experiment, that the magnitude of the evil of drought in this country is such, that the Government cannot safely meddle; from the just fear that it will lead to an undue expectation of relief, and to a less economic and frugal use of the stock in hand; and that any interference on the part of Government with the grain trade however cautiously attempted, paralyzes private effort, and aggravates the general distress, and that the present system is consequently right; there is one means of future alleviation, which might gradually lessen the present amount of evil, still open to the Government. If the well-lands of the country were relieved from taxation, and advances made generally to ryots (as practised partially in South Arcot in 1836) to deepen and enlarge their wells, or to construct new ones, it is probable, that the capability of the country to bear up under the visitation of famine, could be greatly increased, and the permanent resources of the Government proportionally improved. And if it be certain, that no measure for adding directly and immediately to the food of the people in periods of drought is practicable, this would then seem to be the best safeguard against famine with all its present horrors, and national loss; and this measure at least, might perhaps be pressed on the attention of the Government, as an act at once of duty, and of the soundest policy.

Madras, *March* 1839.

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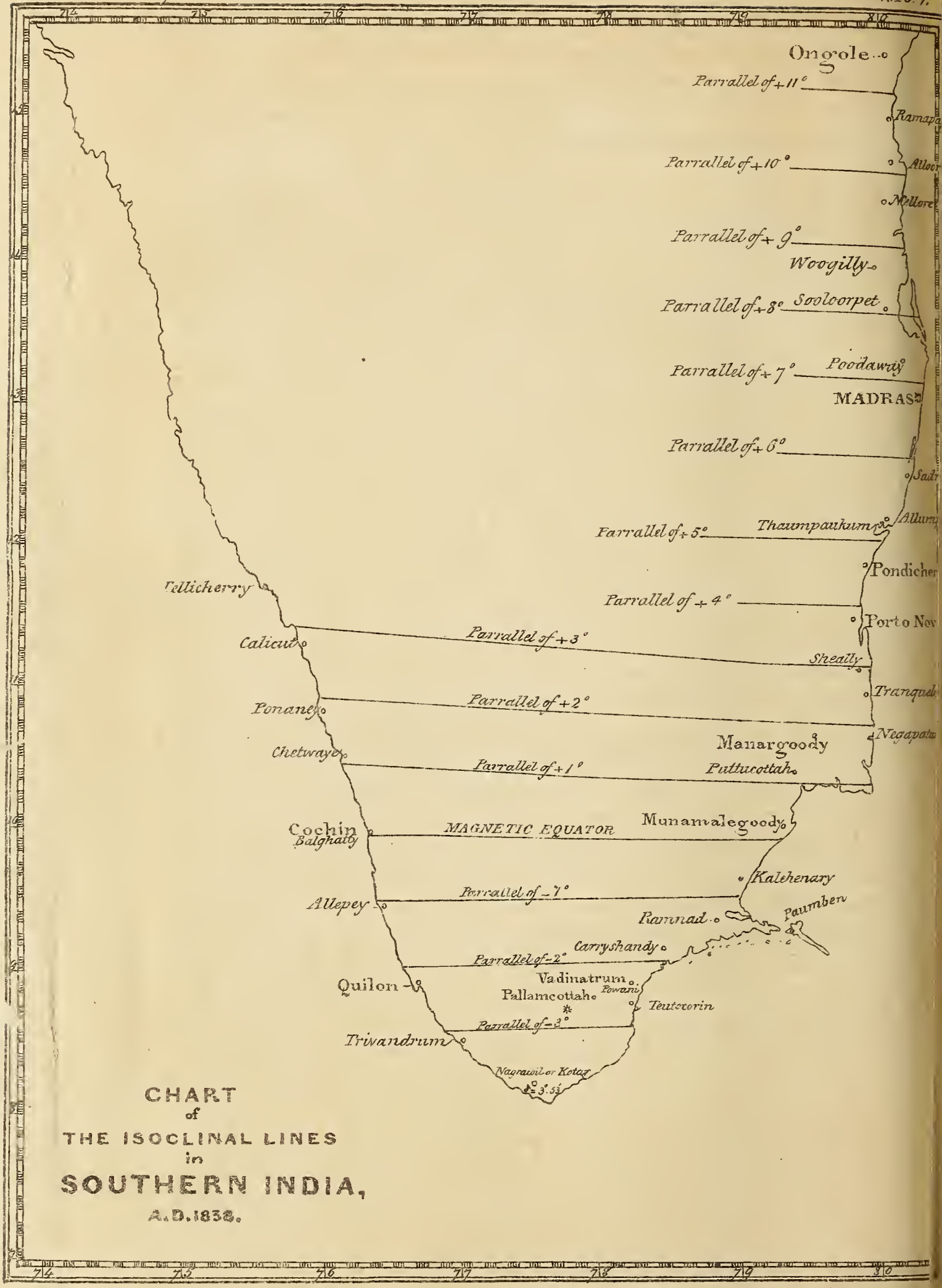


CHART
of
THE ISOCLINAL LINES
in
SOUTHERN INDIA,
A.D. 1838.

II.—*Observations on the Direction and Intensity of the Terrestrial Magnetic Force in Southern India, made by* THOMAS GLANVILLE TAYLOR, Esq. *Astronomer to the Honourable East India Company, and* JOHN CALDECOTT, Esq. *Director of the Trivandrum Observatory.—Communicated by the former Gentleman.*

As far back as the year 1831, at the suggestion of Professor Kupffer, I had projected making a series of observations upon the magnetic dip and intensity in India; but having failed in procuring the necessary apparatus here, and having been equally unfortunate in an application in England, I was necessarily compelled, *pro temp.* to give up my intention. In the year 1837, having been favoured by Captain Moresby, of the Indian Navy, with the loan of a dipping needle, which had been supplied to him by the Geographical Society of Bombay, for the express purpose of making observations upon the coast of India;* and having, through the kindness of Captain Drinkwater Bethune, R. N., been favoured with the temporary loan of two of the intensity needles, which had been employed in the magnetic survey of Ireland; I determined to employ the former, and to construct some needles of the latter description, wherewith to undertake for India, a series of observations similar to that so ably accomplished in Ireland.

With regard to the plan of observation; the lines of equal dip and intensity in India being nearly parallels of latitude, it was evident that the observations should be made in a line at right angles to these, or along the coast; accordingly I resolved on commencing at *Ongole*, in lat. 15° 12′ N., and proceeding at intervals of 20 or 30 miles along the coast to Cape Comorin (the southern extremity of the Peninsula); and from thence along the western coast to Goa.

To have performed the whole of this by myself, would have taken up more time than could be conveniently spared consistently with the prosecution of my astronomical duties; which determined me to invite the assistance of individuals resident in India, to take a part in the observations. My application was not long in meeting with attention from many in various parts of India; but the aid of only one of these (J. Caldecott, Esq. of the Trivandrum Observatory†) was available to an extent which promised to be useful. Accordingly I lost no time in making

* The Geographical Society of Bombay were pleased, subsequently, to allow me to retain the needles so long as I found occasion for them.

† The Observatory at Trivandrum, having been very lately established, is perhaps at present but little known, but the excellence of its arrangements, and the superiority of the instruments which have been ordered, added to the indefatigable zeal of its superintendent, cannot fail soon to render it an establishment of importance.

arrangements with Mr. Caldecott, as to the parts we should each take in the labour; when it was eventually agreed that I should undertake the observations on the eastern, and that Mr. Caldecott should make those upon the western, coast.

For this purpose I left Madras on the 23d day of July 1837, and proceeded to the southward, making observations every day, at intervals of about twenty-five miles; until on the 2d August I arrived at Tranquebar. Here I was met by Mr. Caldecott, whose zeal in the cause would not allow me to make my own observations unassisted. In the observations for dip, I had hitherto only found time to employ three out of the four needles supplied, viz. Nos. 1, 2 and 3; but the presence of Mr. Caldecott suggested the propriety of employing the remaining needle (No. 4), and of taking a double set of observations. This would have been accomplished, but that a few preliminary trials at Tranquebar with needle No. 4, convinced us of its utter uselessness for the purpose intended, in consequence of the want of roundness of the steel pivots. This discovery led to a minute examination of the other needles; when No. 2, (which had in the course of observation exhibited singularly discordant results), appeared likewise to differ from a cylinder in the form of its pivots. These circumstances naturally led to the rejection of the observations hitherto made with needle No. 2, and the *non*-employment of No. 4 in the remaining parts of the work. But, before proceeding further, I may as well give some

Account of the Instruments employed.

They consisted of a dip apparatus by Gilbert, furnished with four needles (two useless) of 4½ inches in length; a pocket chronometer by Arnold, and three intensity needles. The dipping needles were apparently cut out of flat plates of steel, and were hardened at the ends (see fig. 1); the agate planes, Ys for centering, and levels, &c. &c. differed in no respect from the ordinary construction. The intensity needles I had caused to be constructed here, after the plan of Captain Bethune's, to agree nearly with the model of those of Professor Hansteen; viz. each needle was 2,7 inches in length, and 15 inches in breadth, cylindrical, and rounded at the ends;* they were first turned in a lathe, from pieces of English steel wire, and then hardened by plunging them, when at a pale red heat, into cold water; after which they were softened in the middle by placing them upon a red-hot poker. They were now mag-

*Professor Hansteen's were pointed at the ends.

Fig. 1.

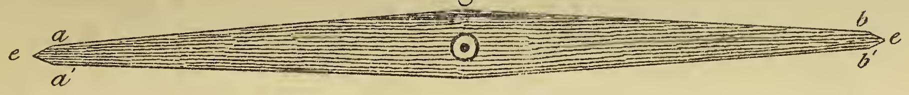


Fig. 2.

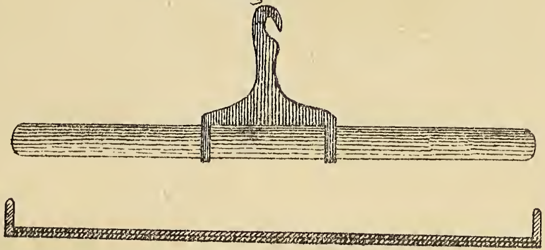
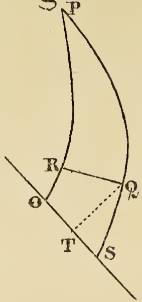


Fig. 3.



netized to saturation by a powerful magnet, and employed during two months previously to my departure, for the purpose of discovering if their intensities remained constant. Each needle was fitted into a brass stirrup (see fig. 2), for the purpose of being attached to a few filaments of untwisted silk, by which it was suspended when in use; and when unemployed, was fitted with an armature of soft iron. When the observation was to be made, the needle was suspended in a square wooden box, of four inches on the side, and 1¼ inches high; the top of this box was fitted with a plate of glass, in the centre of which the end of a hollow glass cylinder of eight inches in length (a piece of broken barometer tube) was cemented; to the upper end of this cylinder, one end of the silk filaments supporting the needle was secured, so as, passing through the cylinder, to leave the needle suspended by the other end at half an inch above the bottom of the box, when its oscillations could be seen through the glass plate at top, or through two glass windows, placed opposite to each other in the sides. At the bottom of the box inside, a line was drawn in the direction of the two windows; and at angles of 20 degrees on either side of this, were drawn two other lines; the centre line being made to correspond with the direction taken up by the needle when at rest (the magnetic meridian), and the other lines, exhibiting azimuths of 20° to the east and west of this, shewing the arcs at which the observations were always to commence. On one side of this box a delicate thermometer was fixed, whose indications could likewise be seen through the glass plate at top. The pocket chronometer by Arnold was one of ordinary goodness; in addition to which Mr. Caldecott had provided himself with a pocket chronometer by Barraud, and an artificial horizon and sextant, for determining the latitudes of places which could not be identified on the map. We will now mention one or two

Particulars with regard to the modes of observing.

Hitherto, it had been my custom to watch the decreasing vibrations of the dipping needle, and register its indication when stationary. Such a mode of observation, however, often led to unsatisfactory results; for, on tapping the apparatus gently, without un-centering the needle, it frequently exhibited an altered position, to the amount sometimes of forty or fifty minutes; and an approximate result only could be obtained, by taking the mean of the readings after repeatedly tapping and re-centering the needle. This circumstance led to an alteration in the mode of observing, which consisted of first centering the needle on the agate planes,

and then, by means of a magnet, causing it to vibrate through an arc of 60° (i. e. 30° on either side of the stationary position), and noting the successive diminishing arcs of vibration of one of the ends; after which the needle was again centered, and the arcs of vibration of the other end similarly read off &c. &c., when the stationary point was obtained by interpolation. Thus at Tranquebar, August 9th, Needle No. 1.—

End A Vibrated from	to	δ =	End B Vibrated from	to	δ =
°	°	°	°	°	°
— 33,9			— 30,9		
	+ 27,0	∴ —2,75		+ 24,3	∴ —2,62
— 31,1			— 28,2		
	+ 24,2	2,77		+ 21,7	2,60
— 28,4			— 25,6		
	+ 21,6	2,75		+ 19,3	2,55
— 25,8			— 23,2		
	+ 19,2	2,70		+ 16,9	2,55
— 23,4			— 20,8		
	+ 16,9	2,65		+ 14,6	2,57
— 21,0			— 18,5		
Mean	=	—2,72		=	— 2,58

and the mean of both readings = 2°, 65 = 2° 39′.

In this way, five or six readings were generally obtained in each of the eight several positions of the needle, and, in addition to this, the readings, when the needle had come to rest, were likewise registered; thus, in the case just cited, the whole of the readings when reduced* were as follows:—

	Readings when at rest.				Readings when osciilating.			
	°	′	°	′	°	′	°	′
Face of Inst. east: axis direct	— 3	35	— 3	40	— 3	4	— 3	10
—— west ——	— 3	5	— 3	5	— 2	52	— 2	57
—— —— invd.	— 3	7	— 3	15	— 3	4	— 3	14
—— east ——	— 3	20	— 3	10	— 2	43	— 2	35

Reversed the poles

* The observations of the needle when vibrating were read off in degrees and *tenths* of a degree, in consequence of the rapidity of the vibrations not affording time to register two figures, which generally would occur in the minutes;—the error of reading very rarely exceeded one-tenth of a degree, or six minutes.

	° ′	° ′	° ′	° ′
Face of Inst. east : axis direct	+ 8 10	+ 8 15	+ 7 54	+ 8 6
—— west ——	7 10	7 0	7 16	7 3
—— —— invd.	8 15	8 0	7 25	7 17
—— east ——	7 15	7 25	7 4	7 8
The mean =	+ 2° 12′ 52″	+ 2° 11′ 15″	+ 2° 14′ 30″	+ 2° 12′ 15″
∴ The true dip of δ =	+ 2° 12′ 4″			+ 2° 13′ 22″

The above is one case out of many which occur, in which although large differences are found in the several single readings, still the means are coincident; other cases there are, however, in which the means disagree: thus—

	Mean of Readings when at rest.	Mean of Readings when oscillating.	Difference.
At Negapatam Needle No. 1 gave δ =	+ 2° 46′ 41″	+ 2° 31′ 30″	0° 15′ 11″
—— No. 3 —— =	1 6 30	1 22 54	0 16 24
Tranquebar No. 3 =	1 47 48	2 11 11	0 23 23

These results from the needles when vibrating appearing invariably more consistent than those derived in the usual way, I have not hesitated to give them the preference, and reject the stationary observations.

The observations with the intensity needles require but little notice here, beyond the mention that they have been uniformly made by noting the time of describing the first, second, and third hundred vibrations, commencing from an arc of 20 degrees on either side of the meridian. Added to this, it only remains to state that the observations both for dip and intensity were uniformly commenced between the hours of 9 and 10 in the morning, and finished at 2 or 3 in the afternoon.—We will now resume our journey.

We left Tranquebar on the evening of the 13th August, and proceeded to the southward, making observations every day (at distances of from 20 to 25 miles), and arrived at Trivandrum on the 26th August. Here we had leisure to examine our observations; and the result of it, as will appear in the sequel, was not so satisfactory as could be wished: it exhibited an uncertainty in the dip observations at several places, to some amount, and the intensity observations were not altogether free from blame. This determined me to re-observe on my return homeward, at those places at which doubtful results had been obtained; and, having met with a clever

workman (in the person attached to the Trivandrum Observatory, for the purpose of repairing instruments, &c.) I procured the re-turning of the pivots of the hitherto useless needles (No. 2 and 4), and the construction of two new intensity needles.

Thus equipped I left Trivandrum on the 20th September, and employing all four of the dipping needles and five intensity needles—which practice had now enabled me to accomplish unassisted—I again made observations at those places which had hitherto given contradictory results; and eventually arrived at Madras on the 15th October.

It had been agreed upon by Mr. Caldecott and myself, that, before completing the observations to the northward of Madras, the instruments should be sent to him, to perform a portion of the work to the northward of Trivandrum; this was done, and the observations, as far as Tellicherry, were made by Mr. Caldecott, in the month of November following. It had been Mr. Caldecott's intention to have completed the series on the western coast at a no very distant date: but the unsatisfactory results now arrived at, induced him to await the arrival of a new dip apparatus and needles from England (which he had ordered of Mr. Thomas Jones for this purpose), and to return the needles to me for the prosecution of the observations on this coast. I was anxious for the completion of the work, but had already been too long absent from the Observatory, whereby computations had accumulated, and observations had been neglected to some extent; thus circumstanced, I availed myself of the services of a very intelligent and careful native (Tannyachellum) who, after making observations on the dip and intensity every day during three months, had acquired as correct a habit of observing as could be expected or desired. Tannyachellum accordingly was despatched from Madras on the 27th April 1838, with directions to make observations of the dip and intensity at distances of about 25 miles apart, from hence, along the coast as far as Ongole; and to re-observe at the same places on his return. This was accomplished by the end of June; and with the exception that the dip observations were made in the usual way, *not by our method of "vibrations,"* I venture to assert that the results he has obtained, are not less accurate than I might have arrived at myself.

The new dip apparatus by Jones, much to our disappointment, did not arrive at Madras till September 1838, just before Mr. Caldecott's departure for England: on examination it appeared in every respect to be a very superior instrument; but the results arrived at here, both by Mr. Caldecott and myself (Mr. Caldecott being at Madras by this time) were

not more accordant than those already obtained from the other needles. Notwithstanding this, Mr. Caldecott, at some considerable inconvenience to himself, repeated his observations with the new needle at Cochin and Allepee, previously to his departure for Europe. I have thought it necessary to mention these particulars, in order to account for having so long delayed fulfilling my promise of giving these observations: but my desire to render the work complete, *even now makes it doubtful if I had not better wait for the observations on the western coast;* but, with thus much by way of apology, and the promise that, at some future, not far distant time, the observations on the western coast will be completed; we may at once turn to the observations, and their discussion: and, since there will be much to say in the way of discussion, it may be as well to leave the intensity observations for the present, and commence the

Discussion of the Dip Observations.

The discordant results which have been met with by Captain Sabine* and others in measuring the dip by different instruments, renders it desirable that a comparison of the needles now used with others should be instituted; accordingly I have availed myself of two observations made here with a dip apparatus belonging to Captain Drinkwater Bethune R. N., and of three observations made with Mr. Caldecott's needles—we get altogether as follows:—

					Dip for Madras. ° ′ ″	° ′ ″
Needle	D. B.	No. 1	from 1	observation δ =	+ 6 55 4	+6 52 30
——	D. B.	,, 2	—— 1	—— =	6 49 56	
——	T. G. T.	,, 1	—— 2	—— =	6 45 22	+6 50 9
——	T. G. T.	,, 2	—— 1	—— =	6 44 13	
——	T. G. T.	,, 3	—— 2	—— =	6 56 56	
——	T. G. T.	,, 4	—— 1	—— =	6 54 4	
——	J. C.	,, 1	—— 1	—— =	6 51 34	+6 52 30
——	J. C.	,, 2	—— 2	—— =	6 53 26	
	Mean		——	—— =	6 51 19	

The discrepancies here met with, probably for the most part arise from error of observation; since only one or two results from each needle have

* In the observations lately made for the magnetic survey of Ireland, there appears, in an extreme case, a difference of 41′ between the results from two of the needles employed.

been obtained: we perceive, that, employing the needles 1 and 3 T. G. T., an error from the mean of a few seconds only would be committed: and that employing 1. 2. 3, and 4, T. G. T. or 1, and 2 J. C., in either case our results would, as far as constant error is concerned—possess nearly the same degree of accuracy as if made from the whole 8 needles.

In the Report of the British Association relative to the magnetic observations made in Ireland, it is mentioned, "of the eight results obtained with needle (P), there is only one which differs from the mean "of the eight by a single minute." Such accuracy, however, cannot be the boast of the Madras observations; for, as it will be seen presently, a *single degree*, instead of a single minute, will occasionally be thrusting itself in, between observation and the truth. But, not to be too hasty in statements, it may be as well to mention, that, by reason of the feebleness of magnetic force in India, arising from proximity to the magnetic equator on the one hand, and high temperature on the other, one carefully made set of dip observations under every advantage, cannot be expected to arrive nearer than within 8 or 10 minutes of the truth. On looking over the whole of the results, however, discordances are found to an amount far exceeding this, —one indeed which would render the observations altogether useless, were there no means left of accounting and making allowance for the same. I became aware of the discordances which affect our observations, when at work on their reduction at Trivandrum: at first I felt inclined to attribute the discrepancies to local causes and error, but a little reflection convinced me that I must give up such a supposition, since, from the care we had taken in every particular, the one was highly improbable and the other impossible; for we had been careful to observe in sheds or under trees, far removed from local disturbing causes, and had not omitted to lay aside our keys and the buckles from our stocks and braces, &c.; so that we must look to some other cause for an explanation of the discrepancies.

In the course of our travels, I had noticed at one place (*Carryshandy* I think), that, on applying the magnet to one end of the needle to ascertain the position of the poles, the edge *a* (fig. 1) attracted the needle and *a'* repelled it; but, on again applying the magnet to *a*, its pole had become changed to the same denomination as *a'*; and on immediately vibrating the needle, its inclination had altered about 50 minutes. Having at Trivandrum met with a similar anomaly, I was led to enquire, whether the discrepancies which appeared in some of the observations could not be accounted for in this way: might not the magnet, in the act of reversing the poles, have pressed upon one edge, and have established a pole at *a* or *a'* instead of the end *e*? To resolve this difficulty, I availed myself

of a very bad observation (one in which I had purposely been careless), and one which proved very discordant, to discover, by thrusting the needle among some iron filings, where the poles were situated; when, my discordant observation was fully explained by the poles having chosen to take up a position at *a* and *b*, forming an angle of 1¾ degrees with the ends *e* and *e′*.

I now, for the sake of variety, inclined the magnets a little, so as to establish the poles at *a′* and *b′*, and, as might be expected, a result differing 3½ degrees from that just made, immediately resulted: the former being as much in excess as the latter was in defect.

I now set to work systematically—thus—at Trivandrum August 30th—13th September 1837.—

Needle employed.	Observed dip. ° ′ ″	Remarks.
Needle No. 1 =	—3 17 30	Each result being the mean of 5 observations in one position of the needle only; made with the greatest possible care, that the poles should be setled at the ends *e* *e′*.
——— =	3 20 0	
——— =	3 22 3	
——— =	3 22 30	
——— =	— 4 7 0	Each derived from 5 observations in the same position as above, by causing a slight degree of inclination in one of the magnets, whereby the poles were situated at *e* and *a*.
——— =	4 7 0	
——— =	— 4 56 0	From the mean of 5 observations in the same position as above, magnetized by inclining both magnets slightly, whereby the poles took up the position *b′* and *a*.
Needle No. 4 =	+ 0 22 30	Each result being derived from 5 observations in one position of the needle only, magnetized by causing a slight inclination of both magnets, or poles at *a′* and *b*.
———	+ 0 17 30	
——— =	— 0 37 30	Each result being derived from 5 observations in the same position as above, inclining one of the magnets only, or poles at *e* and *a′*.
——— =	0 37 30	
——— =	0 35 30	
——— =	1 17 30	Each result being determined from 5 observations in the same position as above, both magnets being drawn to the ends; or poles at *e* and *e′*.
——— =	1 17 30	

In a similar way the following were obtained—

	° ′ ″	
Needle No. 3—	3 55 23	Mean of 8 observations, poles at *a* and *b′*
———	3 20 0	——— ——— ——— *e* and *e′*
———	1 42 30	——— ——— ——— *a′* and *b*

	° ′ ″		
Needle No. 2—4	7 10	Mean of 8 observations, poles at	*b′* and *a*
———	2 22 56	—— —— ——	*a* and *b*
———	2 22 43	—— —— ——	*e* and *e′*
———	2 28 41	—— —— ——	*a′* and *b′*

The above results, being derived from one position of the needle only, do not represent the *true* dip, but furnish, by means of differences, what we require: thus, taking the means—

Needle No. 1 shews—that if the poles, instead of being situated at *e*, *e′* should take up a position such as *e* and *a*, (which in practice has occasionally occurred) then, the reading would be erroneous to the amount ± 0°,49′,0″; and that, in an extreme case, when both poles are astray, then an error in the reading to nearly double of this amount (or ± 1°,35′,23″) results—or, we obtain on the whole.

The Poles being situated at

Needle.	*e* & *e′*	*a* & *b*	*a′* & *b′*	*e* & {*b*, *b′*} *e′* & {*a*, *a′*}	*a* & *b′* *a′* & *b*
	error. ° ′	error. ° ′	error. ° ′	error. ° ′	error. ° ′
No. 1	0 0			+0 46	+ 1 35
— 2	0 0	0 0	+ 0 6		1 44
— 3	0 0				1 37
— 4	0 0			+0 37	1 37
Mean.	0 0	0 0	+ 0 6	+0 42	+ 1 38

A greater degree of consistency would no doubt exist between these numbers, were the ends of the needles symmetrical, and of exactly the same size; then we should expect to find

		° ′
Poles *e* and *e′*	the error of observation	= 0 0
a and *b* or *a′* and *b′*	—— ——	= 0 0
e and *b* or *e* and *b′* *e′* and *a* or *e′* and *a′* }	— ——	= ± 0 49
a and *b′* or *a′* and *b*	—— ——	= ± 1 38

The greatest disagreement from these being in the case of needle No. 4, (poles at *e* and *a′*), I have, since writing the above, turned to

examine it, when the want of symmetry in one of its ends, fully justifies the accuracy of the $\pm 0°,37'$ found above. The other needles are, however, singularly perfect; so that the mean values here found belong to needles Nos. 1, 2, and 3; and for No. 4 as far as concerns the poles *a* and *b'* and *a'* and *b*; but for the positions *e* and *a'* the correction $= -0°.37'$
and we may conclude, for —— —— *e* and *b'* —— —— $= +1.\ 1$
and for the remaining positions *e'* and *b* and *e'* and *a* —— $= \pm 0.49$

In the actual determination of the dip, however, it is necessary to invert the poles: so that putting p and $\frac{p}{2}$ for the corrections which apply to needles Nos. 1, 2, and 3; we may

in one position of the poles of the needle—read off ...... $\begin{cases} A \\ A \pm \frac{p}{2} \\ A \pm p \end{cases}$

and in the inverted position of the poles we might read off . $\begin{cases} B \\ B \pm \frac{p}{2} \\ B \pm p \end{cases}$

where $\frac{A + B}{2} = \delta$ the true dip, or, taking all the possible combinations of these six readings, the values for δ, resulting from either of the needles 1, 2, or 3, and for several cases of No. 4,

			° ′ ″
are	$\frac{A + B}{2}$	or	$\delta \pm 0.\ 0.\ 0$
	$\frac{A + B}{2} \pm \frac{p}{4}$	or	$\delta \pm 0.24.30$
	$\frac{A + B}{2} \pm \frac{p}{2}$	or	$\delta \pm 0.49.\ 0$
	$\frac{A + B}{2} \pm \frac{3p}{4}$	or	$\delta \pm 1.13.30$
	$\frac{A + B}{2} \pm p$	or	$\delta \pm 1.38.\ 0$:—

and since, in the remaining cases of needle No. 4, there are several values entering, which the observations afford no clue to identify, if they are—poles at *e* and *a'* or at *e* and *b'*, it will in cases of doubt be as well to reject the observations of needle No. 4. With this view of the case, and recollecting that among several independant observations,—in the greater number of cases no correction whatever will be necessary—the poles will have identified themselves with the extreme ends of the needle,—we will now consult Table I, and endeavour to discover what proper compensations may be applied to the values there given, to obtain the true values of δ

TABLE I. DIP OBSERVATIONS, &c.

Date.	Place of Observation.	δ Needle I.	δ Needle II.	δ Needle III.	δ Needle IV.	Observed by	Site—Remarks, &c.
1838		° ′ ″	° ′ ″	° ′ ″	° ′ ″		
May 19	Ongole	+11.46.15	+ 11.43.26	+ 10.45.37	+ 11.43. 7	T.	On the bank of the *red* tank, (the village lying on the south, and the traveller's bungalow distant 100 yards to the east) under the shade of a tree.
20	———	11.31.53	11.56.15	11 25.37	12.23.45	T.	
May 16	Ramahpatam	+11.15.37	+ 11.11.31	+ 10.15.37	+ 11.13. 7	T.	In Mr. Elliot's compound,—under the shade of a tree.
23	———	10.36.31	10.35 37	10.46.15	11.26.34	T.	
May 14	Alloor	+10.17.11	+ 10.20.19	+ 9.50.56	+ 10.21.53	T.	In a cadjan shed attached to the tasildar's cutcherry.
27	———	10.17.11	10.26.34	10.16.53	9.50.19	T.	
May 12	Nellore	+10.35.19	+ 9 45.57	+ 9.30.37	+ 9.43.26	T.	In *Singaryah's* garden, under the shade of the banyan tree.
29	———	9.46.15	9.33.26	10.31 53	9.24.23	T.	
May 9	Woojelly	+ 8.23.45	+ 9.11.53	+ 8.49.41	+ 8.43.26	T.	100 yards to the south of the traveller's bungalow, under the shade of a banyan tree.
June 1	———	8.50.37	8.52 30	8.53.26	8.14.41	T.	
May 7	Sooloorpet	+ 8. 6.53	+ 8.10.37	+ 7.27 11	+ 8. 5.56	T.	In the weaver's grove close to the traveller's bungalow.
June 3	———	8.11.34	8.16.34	8.11.15	7.29. 4	T.	
May 28	Poodaway	+ 7.18.26	+ 7.14. 4	+ 7.23.26	7.16.53	T.	Ellamas's grove under a banyan tree
29	———	6.15.56	7.11.53	6.58.45	7.43.26	T.	do. do.
June 7	———	7.10.37	7. 8 45	9. 2.49	6. 0.37	T.	do. do.
1837							
April 26	Madras	+ *6.49.56	+* 6.46.52			D. B. & T. G. T.	In the observatory dwelling house.
26	———	*6.55. 4				D. B. & T. G. T.	Do.
July 17	———	6.49.49		+ 6.54.30		T. G. T.	In the observatory.
Oct. 16	———	6.40.56		6.59.22	+ 6.54. 4	T. G. T.	Do.
1838							
April 3	———	6. 7.30	6.30.19	7.34.41	6.50.37	T.	Do.
5	———	6.16. 4	6.53. 7	7.46.53	6.40.19	T.	Do.

Date.	Place of Observation.	δ Needle I.	δ Needle II.	δ Needle III.	δ Needle IV.	Observed by	Site—Remarks, &c.
		° ′ ″	° ′ ″	° ′ ″	° ′ ″		
1839							
Jan. 29	Madras		+* 6.55. 0			T. G T.	
Feb. 11	——	+**6.51.34	** 6.53.26			T. G. T.	
1838							
July 24	Sadras	+ 5.39.15		+ 5.30. 0		T. G. T.	In the traveller's bungalow.
Oct 14	——	5.30.18	+ 5.28. 7	5.22.30	+ 5.38. 7	T. G T.	
July 25	Thaumpaukum	+ 4.43.42		+ 5.12. 7		T. G. T.	Under the shade of a tree.
Oct. 13	Allumparva	+ 4.50.37	+ 4.48.23	+ 4.52.12	+ 5. 4.22	T. G. T.	Under a cadjan shed.
July 26	Pondicherry	+ 4.31.41	+ 4.25.56	+ 4.43·33	+ 4.25.56	T. G. T.	The master attendant's office.
27	——	4.21.34		4.12.19		T. G. T.	do.
28	——	4.31.15		4. 0.22		T. G. T.	do.
Oct. 12	——	4.20.57	4.25.18	4.27.11	+ 4.30 0	T. G. T.	The verandah of the post master's house.
July 31	Porto Novo	+ 3.24.22		+ 3. 0.23		T. G. T.	In Mr. Pugh's house.
Aug. 1	——	3.16.15		3. 3.52		T. G. T.	do.
Oct. 11	——	3. 8.26	3.11.52	3. 8.45	+ 3. 0.37	T. G. T	do.
Aug. 2	Sheally	+ 2.19.22		+ 2. 0. 0		T. G. T.	In the verandah of the traveller's bungalow.
Oct. 10	——	2.33. 7	+ 2.31.34	2.30. 0	+ 2. 6.15	T. G. T.	
1837.							
Aug. 3	Tranquebar	+ 2. 4.10		+ 1.58. 7		T. G. T.	In the guard room.
7	——	1.56.52		1.55.46		T. G. T. & J. C.	On top of the house.
8	——	2. 6.52		2.11.11		T. G. T. & J. C.	In the guard room.
9	——	2.13.22		2 8.45		T. G. T. & J. C.	do.
Oct. 9	——	2.11.15	+ 2.19. 8	2. 2.37	+ 1.48.26	T. G. T.	do.
Aug. 12	Negapatam	+ 2.32. 6		+ 1.22.54		T. G. T.	An open shed.
13	——	2.31.30		0.44.41		T. G. T. & J. C.	do.

* Observed with Captain D. Bethune's Instrument. ** Observed with Mr. Caldecott's new Instrument.

Date.	Place of Observation.	δ Needle I.	δ Needle II.	δ Needle III.	δ Needle IV.	Observed by	Site—Remarks, &c.
		° ′ ″	° ′ ″	° ′ ″	° ′ ″		
1837 Oct. 2	Negapatam	+ 1.43,45	+ 1.23. 7	+ 0.21.33	+ 1.33.15	T. G. T.	Verandah of the hospital.
Aug. 13	Manargoody	+ 1, 4.41		+ 0.38. 5		T. G. T. & J. C.	Verandah of the missionary bungalow
14	Puttucottah	+ 0.52.37		+ 0.57.23		T. G. T. & J. C.	Verandah of the choultry.
15	Munamalegoody	+ 0. 7. 0		+ 0.15.17		T. G. T. & J. C.	do.
16	Kalehennary	+ 0. 4.15		+ 0 .8.30		T. G. T. & J. C.	do.
17	Ramuad	— 1.28,37		— 1.20.49		T. G. T. & J. C.	Verandah of the commanding officer's quarters.
Sept 30	Paumban	— 1.49. 3	— 1.24.22	— 1.34.43	— 1. 9.22	T. G. T.	Verandah of the Engineer's bungalow.
Aug. 20	Carryshandy	— 1.51.15		— 1.52.30		T. G. T. & J. C.	Verandah of the choultry.
21	Vadinatum	— 1.37.31		— 1.30.11		T. G. T. & J. C.	Open air near to the choultry—A hot land wind with much dust.
22	Powani	— 2.43.54		— 2.49.26		T. G. T. & J. C.	Mud hut belonging to the Missionaries. A hot and strong land wind—observation effected with difficulty.
Sept. 26	Tutocorin	— 2,27.30	— 2.45, 0	— 2.40.37	— 2.11.10	T. G. T.	In the verandah of Mr. Cory's house.
Aug. 23	Pallamcottah	— 1.50.26		— 2.48.45		T. G. T. & J. C.	In a cocoanut tope situated 20″ N. of the fort.
Sept. 22	———	2.48.26	— 2.48.45	2.40.19	— 2.46.34	T. G. T.	Verandah of a house in the middle of the fort.
Aug. 25	Nagracoil	— 3.54,26		— 3.51. 4		T. G. T. & J. C.	Verandah of the Missionary's house (Mr. Miller's).
Sept. 21	——=	4. 4.22	— 4 14.23	3.28.26	— 3.38.42	T. G. T.	do. do. (Mr. Malt's)

Date.	Place of Observation.	δ Needle I.	δ Needle II.	δ Needle III.	δ Needle IV.	Observed by	Site—Remarks, &c.
		° ′ ″	° ′ ″	° ′ ″	° ′ ″		
Aug. 28	Trivandrum	— 3,10,26		— 3.17.23		T. G. T. & J. C.	Meteorological bungalow.
Sept. 5	——	3. 4. 4	— 3 23.34	3.17.30		T. G. T. & J. C.	do.
13	——	3.10.56	3.17.49	3.24.26	— 2.35 37	T. G. T. & J. C.	do.
Nov. 20	——	2.41.53	2.58 7			J. C.	do.
20	——	3.13.11	3, 7.55			J. C.	do.
1838 Dec. 15	——	3.24. 4				J. C.	do.
1837 Nov. 15	Quilon	— 2.28. 8				J. C.	Residency grounds—in a mango tope, at about 100 yards to the south of the house.
1838 Dec. 15	——	* 2.15. 3					
1837 Nov. 12	Allepee.	2.12.49	— 2.30.19			J. C.	In a thatched shed in Mr. Anderson's compound, south of the house.
Nov. 12	——	1.59.41	1.57.12			J. C.	In a thatched shed in Mr. Anderson's compound, south of the house.
1[illegible]	——	0.57.49				J. C.	do. do.
1[illegible]	——	1. 1.15				J. C.	do. do.
1838 Dec. 20	——	* 2.37. 0				J. C.	do do.
1837 Nov. 8	Balghatty	+ 0.31,34	+ 0.17.30			J. C.	The Residency compound in a tent.
8	——	0.14. 4	0 41.53			J. C.	do. do.
8	——	0.18. 5	0. 5.37			J. C.	do. do.
8	——	——	0. 4.22			J. C.	do. do.
1838 Dec. 21	——	* 0.10. 6	* 0.21.18			J. C.	do. do.

* Observed with a new Dip apparatus by Mr. T. Jones.

Date.	Place of Observation.	δ Needle I.	δ Needle II.	δ Needle III.	δ Needle IV.	Observed by	Site—Remarks, &c.
		° ′ ″	° ′ ″	° ′ ″	° ′ ″		
1837 Nov. 6	Chetwaye	+ 1. 3.26	+ 1.17.30			J. C.	The N. E. room of the public bungalow (thatched).
	——	1.16.15	1. 3. 5			J. C.	
	——	1.17.30	1.17.30			J. C.	
„ 5	Penaney	+ 1. 3. 8	+ 1.19.41			J. C.	The S. W. corner of the public bungalow (thatched).
„ 4	Calicut	+ 1.3[illegible].15	1.51.53	+ 2.26.53	+ 2.12.30	J. C. }	Under a tent pitched on the borders of the sea beach, among the cocoanut trees, 300 yards N. W. of the flag staff.
	——	1.13. 8	1.12.49			J. C. }	

Consulting the above observations, with reference to the remarks at page 231 we may conclude as follows:—

Ongole.—The observations Nos. 1*. 2, 4, 5 and 7 appearing consistent, there is little fear of their not representing the true dip: No. 3 probably requires the second correction or + 0° 49 0": No. 6 the 1st correction, and No. 8 being doubtful, had better be omitted.
($\therefore \delta = -11° 26' 40''$)

Ramyapatam.—Here we have four results, Nos. 3. 5, 6 and 7. telling nearly the same tale, and in all probability the right one: in which case Nos. 1 and 2 require the minor correction—24' 30" and Nos. 4 and 8 the second correction or—0° 49' 0".
($\therefore \delta = +10° 14' 14''$)

Alloor.—Here Nos. 1. 2, 4, 5. 6 and 7 are coincident, exhibiting a deficiency to the amount of the 1st correction + 0°, 24' 30" in Nos. 3 and 8.
($\therefore \delta = +10° 15' 46''$)

Nellore.—Nos. 2, 3, 4, 5, 6 and 8 are coincident: exhibiting an excess in Nos. 1 and 7 to the amount of the 2d correction or—0° 49' 0": and No. 8 probably requires the first correction or + 0° 24' 30", but being doubtful we will omit it.
($\therefore \delta = +9° 41' 16''$)

Woogelly.—Nos. 3, 4. 5, 6 and 7 are coincident, exhibiting a deficiency in No. 1, and an excess in No. 2 to the amount of the minor correction 0° 24' 30": No. 8 being doubtful is omitted.
($\therefore \delta + 8° 49' 20''$)

Sooloorpet.—Nos. 1, 2, 4. 5, 6 and 7 are coincident, exhibiting a deficiency in Nos. 3 and 8 to the amount of the second correction or + 0° 49' 0": but No. 8 had better be omitted.
($\therefore \delta = +8° 11' 17''$)

Poodaway.—These observations are the most discordant of any that have been made: they exhibit in Nos. 14 and 15 nearly the two extreme cases which *can* happen: on looking over the several values, from the coincidence found in Nos. 1. 2, 3. 4, 6. 9 and 10, we naturally conclude that they re-

* These numbers refer to the order in which the values stand in the table.

present the true dip: in which case, Nos. 5 and 12 require the third correction; Nos. 7 and 8 the 1st; and Nos. 11 the 4th or largest correction.

($\therefore \delta = +7° 16' 46''$)

Madras.—Nos. 1, 2, 3, 4, 5, 6, 7, 8, 12, 14, 16, 17, 18 and 19 probably exhibit the true values of the dip—in which case Nos. 9, 11 and 15 require the second correction, and Nos. 10 and 13 require the first or minor correction only.

($\therefore \delta = +6° 50' 4''$)

Sadras.—The general mean will probably be pretty near the truth.

($\therefore \delta = +5° 31' 23''$)

Thaumpaukum.—Nos. 1 or 2 require the minor correction to produce an agreement *inter se*, but since in either case we might possibly be in error, it will be as well to take the mean, and mark the result as *doubtful*.

($\therefore \delta = +4° 57' 54''$) *doubtful.*

Allumparva.—Was visited on my return homeward, instead of Thaumpaukum, in consequence of its affording better shelter than the latter place: the observations all agree pretty well, although No. 4 probably requires the minor correction.

($\therefore \delta = +4° 50' 16''$)

Pondicherry.—The first and third observations with needle No. 3 apparently require the minor correction.

($\therefore \delta = +4° 27' 12''$)

Porto Novo.—The first observations apparently requires the minor correction.

($\therefore \delta = +3° 6' 15''$)

Sheally.—The observations with Nos. 2 and 6 seem to require the minor correction.

($\therefore \delta = +2° 28' 13''$)

Tranquebar.—No. 12, which we may as well omit, seems to require the minor correction.

($\therefore \delta = +2° 5' 17''$)

(*Negapatam.*—It is quite impossible at first sight to form any idea of the true dip from these observations. On consulting those made on 2d October, we may

adopt with equal propriety, the mean of Nos. 1 and 4 (1° 38′ 30″), or of Nos. 2 and 3 (1° 22′ 20) as the true dip. On consulting the previous observations, we find that they may be brought to agree with the first of these values, by allowing the second correction in Nos. 1, 3 and 4, and the first correction in No. 2; whereas to reconcile them with the second value found above, we must admit the *third* correction in Nos. 1 and 3: and the second in No. 4. Hitherto the minor correction only having been found sufficient to reconcile the observations made by myself, I think it little likely that *the third correction should apply twice* at the same station, particularly as the observations on the second day were made with more than ordinary care on account of the disagreement met with on the first day of observation: or, it would appear on the whole that the most probable value for the true dip will be found, by allowing the first correction in Nos. 2, 6 and 7; and the second correction in Nos. 1, 3 (∴ $\delta = +\ 1°\ 42'\ 10''$) and 4.

Manargoody.—One or the other of these observations probably represents the true dip, in which case the other observations requires the minor correction.
(∴ $\delta = +\ 0°\ 39'\ 8''$ or $+\ 1\ \ 3\ \ 38$)

Puttoocottah.—The mean of these is probably pretty near the truth.
(∴ $\delta = +\ 0°\ 55'\ 0''$)

Munamalegoody.—The mean of these is probably pretty near the truth.
(∴ $\delta = +\ 0°\ 10\ \ 34''$)

Kalehenary.— Do. do. ∴ $\delta = +\ 0°\ \ 6'\ 22''$.

Ramnad.— Do. do. ∴ $\delta = -\ 1°\ 24'\ 42''$.

Paumban.—No. 4 appears to require the minor correction.
(∴ $\delta = -\ 1°\ 35'\ 30''$)

Carryshandy.—Observations coincident— $\therefore \delta = -1° 51' 52''$.

Vadinatum.— Do. do. $\therefore \delta = -1\ 33\ 51$.

Powani.— Do. do. $\therefore \delta = -2\ 46\ 10$.

Tutocorin.—No. 4 appears to require the minor correction, but the ($\therefore \delta = -2° 37' 42''$) amount being doubtful it had better be omitted.

Palamcottah.—The large quantity of dust floating in the air, and the hot land wind, rendered observing irksome and difficult on the 24th August, which may account for the magnetising of the needles having been less successfully accomplished than heretofore:—it would appear that No. 1 requires the second correction, and No. 2 the third; but they had ($\therefore \delta = -2° 46' 1''$) better all three be omitted.

Nagracoil.—Nos. 4 and 5 appear each to require the minor correction. ($\therefore \delta = -3° 53' 3''$)

Trivandrum.—The observation with needle No. 4 had better be omitted; Nos. 10 and 11 apparently require the minor ($\therefore \delta = -3° 15' 24''$) correction.

Quilon.—The observations are coincident. $\therefore \delta = -2° 21' 35''$.

Allepee.—These observations are so singularly discordant, that no sort of ($\therefore \delta = -x$) estimate can be made of the value of δ.

Balghatty.—No. 4 apparently requires the minor correction. ($\therefore \delta = +0° 18' 46''$)

Chetwaye.—Observation coincident— $\therefore \delta + 1° 12' 34''$.

Penaney.— do. do.— $\therefore \delta + 1\ 11\ 25$.

Calicut.—Observation coincident— $\therefore \delta + 2\ 42\ 43$

Tellicherry.—The observations made at this place are so singularly discordant, that they had better stand over for the present.

The above values of the dip, when laid down upon a map, exhibit an appearance something resembling a series of parallels of latitude,—save that the errors of observation (which somewhat disturb their uniformity), prevent our discovering if these lines *be* parallel to the equator, or if their inclination tends towards it on the eastern, or on the western side of the Peninsula. To arrive at a more correct knowledge of this matter, we will in the first place suppose them to be parallel, and proceed to find the latitudes of the magnetic equator, corresponding to the several longitudes, from the well known formula

$$\tan \delta = 2 \tan \lambda$$

where δ represents the dip and λ magnetic the latitude of the place. It may be objected—that this formula obtains only on the old hypothesis, of there being two magnetic poles symmetrically situated in a diameter of the earth, and near to its centre,—an hypothesis which is not completely borne out by our present improved knowledge:—however valid this objection may be with reference to high latitudes; a slight consideration of the subject, renders it clear, that in the case of *our* observations (which twice cross the magnetic equator), a result very nearly approaching to the truth will be obtained by this formula: accordingly we get as follows—

Geographical situation of various places on the Coast of India, with the observed Dip, and corresponding deduced Latitude of the Magnetic Equator.

	Long.	Latitude	Obsd. Dip. $\delta_{,}$	Latitude of Mag. Eq.	Remarks.
	° ′ ″	° ′ ″	° ′ ″	° ′ ″	
Ongole..........	80 5 E	15 30 N	+11 36 40	+ 9 38 3	
Ramapatam......	80 6	15 3	10 44 14	9 38 40	
Alloor..........	80 7	14 41	10 18 46	9 29 5	
Nellore.........	79 2	14 28	9 41 16	9 35 17	
Woogelly........	89 58	14 1	8 49 20	9 35 28	
Sooloorpet......	80 3	13 41	8 11 17	9 31 5	
Poodway.........	80 11	13 21	7 16 46	9 42 14	
Madras..........	80 17 12	13 4.9	6 50 4	9 38 23	
Sadras..........	80 12	12 32	5 31 23	9 45 55	
Thaumpaukum.....	80 2	12 12	4 57 54	9 46 46	Doubtful.
Allumparva......	80 2	12 14	4 50 16	9 48 36	
Pondicherry.....	79 54	11 54	4 27 12	9 40 12	
Porto Novo......	79 48	11 29	3 6 15	9 55 48	
Sheally.........	79 50	11 16	2 28 13	10 1 51	
Tranquebar......	79 55	11 1	2 5 17	9 58 21	
Negapatam.......	79 51	10 46	1 42 10	9 51 54	Doubtful.
Manargoody......	79 32	10 40	0 39 8	10 20 26	The latter of these
			1 3 38	10 8 10	is no doubt correct.
Puttoocottah....	79 23	10 27	0 55 0	9 59 30	
Munamelegoody	79 15	10 3	0 10 34	9 57 43	
Kalehernary.....	79 0	9 40	+ 0 6 22	9 36 49	It would appear that this value of δ, requires the 2d correction or $\delta_{,} = -$ 0° 42″ 38′.
Ramnad..........	78 54	9 22	− 1 24 42	10 4 23	
Paumban.........	79 5	9 7	1 35 30	10 4 46	
Carryshandy....	78 27	9 11	1 51 32	10 6 57	
Vadinatrum......	78 10	8 57	1 33 51	9 43 56	This value of δ probably requires the second correction, or $\delta = -$ 2°22′51″.
Powani..........	77 57	8 49	2 46 10	10 1 28	
Tutocorin.......	78 14	8 48	2 37 42	10 6 54	
Palamcottah.....	77 48	8 41	2 46 1	10 7 3	
Nagracoil.......	77 28	8 11	3 53 3	10 7 40	
Trivandrum......	76 59	8 30 35	3 15 24	10 8 22	
Quilon..........	76 56	8 51 0	2 21 35	10 4 49	
Allepee.........	76 21	9 31 0	x		
Balghatty.......	76 17	9 58 30	+ 0 18 46	9 49 7	
Chetwaye........	76 4	10 32 6	1 12 34	9 55 48	
Penaney.........	75 55	10 46 30	1 11 25	10 10 46	
Calicut.........	75 49	11 15 25	2 42 43	9 53 51	
Tellicherry.....		11 45 0			

Neglecting the observation at *Thaumpaukum*, and adopting the second value for *Manargoody*, we get as follows :—

	Latitude.	Longitude.	Lat. of M. Equator.
	° ′	° ′ ″	° ′ ″
From 9 Stations in	12 32 N – 15 30 N	80 6 47	+ 9 37 28
— 13 ———	2 14 N – 9 11 N	79 27 23	9 56 46
— 11 ———	8 57 N – 8 11 N – 11 15 N	77 3 38	10 1 51

On comparing each of these with its several constituent values, we find that the mean error at a single station is 6′, 33″; from which we should conclude, that the latitude of the magnetic equator, derived from the first 9 stations, as far as error of observation goes, is probably not above 2 or 3 minutes in error: and the same may be said of the result from 13, and of that from 11 observations. Hence we are free to infer that the discordance which exists between these three values, as compared with the longitude, is without the limit of error of observations; and since no simple value of inclination of the isoclinal lines would reconcile both the longitudes and latitudes, we are left to conclude, either that the isoclinal lines (arising from local causes) are undulating, or that we have assumed an erroneous theory.

Having come to this conclusion, we will now proceed with the observations at these three groups of stations, to obtain values for the inclination of the isoclinal lines to the meridian (θ); and the rate of variation (r) corresponding to a variation (of one minute for instance) in the latitude. For this purpose, let λ and μ represent respectively the longitude and latitude of any principal station (O) to which we wish to refer a group of observations; and $\lambda_{,}$ and $\mu_{,}$ the same for any one of the other stations. Let P represent the pole of the earth: P O the meridian of the said principal station, and P Q the meridian of any one of the stations which we wish to refer to O. From Q let fall Q R perpendicular to P O; or, since R O and R Q will in no case exceed $1\frac{1}{2}$ or 2 degrees, we may, for simplicity sake, make R O a parallel of latitude; when

$$R\,O = A = \lambda - \lambda_{,}$$
$$\text{and } R\,Q = B = (\mu - \mu_{,}) \cos \lambda_{,}$$

Let O S represent an isoclined line, making the single O S P $=\theta$ with the meridian, and draw Q T $= p$ perpendicular to it; then we get

$$p = (B . \cos \theta + A . \sin \theta) \text{ nearly.}$$

Now, within the limited range of each group of stations, we may safely allow, that the dip varies as the distance—that r remains constant;—hence

$$\delta - \delta_{,} = r\,p$$

or $\delta - \delta_{,} = r \cos \theta . B + r \sin \theta . A$; where, substituting x, and y, for the terms $r . \sin \theta$ & $r . \cos \theta$, and restoring the values of A & B,

$$\delta - \delta_{,} = (\mu - \mu_{,}) \cos \lambda_{,} . \; x + (\lambda - \lambda_{,})\, y .$$

The stations proper to be chosen for principal stations, are evidently those which are situated in the middle of the group, or such as we have already obtained; where

λ	μ	δ
° ′ ″	° ′ ″	° ′ ″
+ 14 2 20	80 6 47	+ 8 46 49
10 33 51	79 27 23	+ 4 11 4
9 24 11	77 3 33	— 1 15 18

whence we deduce the following, for the first group,

Place of observation.	$\lambda_,$	$\mu_,$	A or $(\lambda - \lambda_,)$	B or $(\mu - \mu_,)$ cos. $\lambda_,$	D or $(\delta - \delta_,)$	w
	° ′	° ′			′	
Ongole	+15 30	+80 5	— 88	+ 2	— 169,9	4
Ramapatam	15 3	80 6	61	1	117,4	4
Alloor	14 41	80 7	39	0	92,0	4
Nellore	14 28	80 2	26	5	54,5	4
Woogelly ..	14 1	79 50	+ 1	9	2,5	4
Sooloorpet ...	13 41	80 3	21	4	+ 35,5	4
Podway	13 21	80 11	41	— 4	90,0	6
Madras	13 5	80 17	57	10	116.7	9
Sadras	12 32	80 12	90	5	195,4	3

Similarly we get for the second group.

Place of observation.	$\lambda_,$	$\mu_,$	A or $\lambda - \lambda_,$	B or $(\mu - \mu_,)$ cos. $\lambda_,$	D or $(\delta - \delta_,)$	w
	° ′	° ′			′	
Allumparva	+12 14	+80 2	— 100	— 34	—216 2	3
Pondicherry	11 51	79 54	80	26	193 1	7
Porto Novo......	11 29	79 48	55	20	112 1	4
Sheally	11 16	79 50	42	22	74 1	3
Tranquebar	11 1	79 55	27	27	51 2	6
Negapatam	10 46	79 51	12	23	28 1	3
Manargoody	10 40	79 32	6	5	+ 10 5	2
Puttoocottah	10 27	79 23	+ 7	+ 4	19 1	2
Munamelogoody...	10 3	79 15	31	12	63 5	2
Kalehennary	9 49	79 0	54	26	67 7	2
Ramnad	9 22	78 54	72	32	158 8	2
Paumban	9 17	79 5	77	22	169 6	3
Carryshandy	9 11	78 27	83	59	186 0	2

And further, for the third group.

Place of observation.	$\lambda_,$	$\mu_,$	A or $\lambda - \lambda_,$	B or $(\mu - \mu_,)$ cos. $\lambda_,$	$(\delta - \delta)$	w
	° ′	° ′			′	
Vadinatrum.........	+ 8 57	78 10	+ 27	− 66	+ 18 2	2
Powani	8 49	77 57	35	52	90 9	2
Tutocorin	8 48	78 14	36	69	82 4	4
Palamcottah	8 44	77 48	40	43	90 7	4
Nagracoil	8 11	77 28	73	24	157 8	4
Trivandrum . ..	8 30	76 59	54	+ 5	120 1	7
Quilon........	8 54	76 56	30	8	66 3	2
Allepe......... ...	9 31	76 21	− 7	42	....	....
Balghatty	9 58	76 17	34	46	− 94 1	6
Chetwaye	10 32	76 4	68	59	147 9	4
Penaney	10 46	75 58	82	65	146 7	2
Calicut	11 15	75 49	111	74	238 0	5

We have found above, that

$$\delta - \delta_, = A\,x + B\,y\text{ ;—put } = D$$

and it only remains, that, with the above values of A, B, $(\delta - \delta_,) = D$ and the weight *(w)* (determined from a consideration of the number and goodness of the observations constituting each result) ; we should now, by the method of minimum squares, determine the most probable values for x & y: to accomplish this, we must, after multiplying the above equation by w, again multiply it successively by the coefficients of the quantities sought; when we get equations of the form

$$A^2\,w\,x + A\,B\,w\,y = A\,D\,w$$

and $$A\,B\,w\,x + B^2\,w\,y = B\,D\,w$$

from which, by the following equations of conditions, the most probable values of x and y will now be obtained:

$30976\,x$	$-\ 704\,y$	$= \pm\ 59804{,}8$	$-\ 704\,x$	$+\ 16\,y$	$= -\ 1359{,}2$
14884	− 244	= + 28645,6	− 244	+ 4	= − 469,6
6084	− 0	= + 14352,0	− 0	+ 0	= 0,0
2704	− 520	= + 5668,0	− 520	+ 100	= − 1090,0
4	+ 36	= − 10,0	+ 36	+ 324	= + 90,0
1764	+ 336	= + 2982,0	+ 336	+ 64	= + 568,0
10086	− 984	= + 22140,0	− 984	+ 96	= − 2160,0
29241	− 5130	= + 59867,1	− 5130	+ 900	= − 10503,0
24300	− 1350	= + 52758,0	− 1350	+ 75	= − 2344,8

taking the sum we get

$120043\,x - 8560\,y = 246207{,}5$	$-8560\,x + 1579\,y = -17268{,}6$

and for the second series

$+30000\,x$	$+10200\,y$	$=+64860{,}0$	$+10200\,x$	$+3468\,y$	$=22052{,}4$
44800	+14560	=+108136,0	14560	+4732	=+35144,2
12100	+4400	=+24662,0	4400	, 1600	=+8968,0
5292	+2772	=+9336,6	2772	+1452	=+4890,6
4374	+4374	=+8294,4	4374	+4374	=+8294,4
432	+828	=+1011,6	828	+1587	=+1938,9
72	+60	=−126,0	60	+50	=−105,0
98	+56	=+267,4	56	+32	=+152,8
1922	+744	=+3937,0	744	+288	=+1524,0
5832	+2808	=+7311,6	2808	+1352	=+3520,4
10368	+4608	=+22867,2	4608	+2048	=+10163,2
17787	+5082	=+39177,6	5082	+1452	=+11193,6
13778	+9794	=+30876,0	9794	+6962	=+21948,0

taking the sum we get

$146855\,x + 60286\,y = 320611{,}4$	$60286\,x + 29397\,y = 129685{,}5$

and for the third series

$1458\,x$	$-3564\,y$	$=+982{,}8$	$-3564\,x$	$+8712\,y$	$=-2402{,}4$
2450	−3640	=+6363,0	−3640	+5408	=−9453,6
5184	−9936	=+11865,6	−9936	+19044	=−22742,4
6400	−6880	=+14512,0	−6880	+7396	=−15600,4
21316	−7008	=+46077,6	−7008	+2304	=−15148,8
20412	+1890	=+45397,8	+1890	+175	=+4203,5
1800	+480	=+3978,0	+480	+128	=+1060,8
6936	−9384	=+19196,4	−9384	+12696	=−25971,6
18496	−16048	=+40228,8	−16048	+13924	=−34904,4
13448	−10660	=+24058,8	−10660	+8450	=−19071,0
61605	−41070	=+132090,0	−41070	+27380	=−88060,0

taking the sum we get

$159505\,x - 105820\,y = 344750{,}8$	$-105820\,x + 105617\,y = -228090{,}3$

Resolving these three pairs of equations, we get

x	y
+2,07218	+0,29708
2,35365	−0,41532
2,17310	+0,01770

and since $x = r \sin.\theta$ and $y = r \cos.\theta$; we get

$$\frac{x}{y} = \tan.\theta \qquad \text{or in numbers.}$$

	θ	r	
	° ′	′	
+	81 50	2,0934	for one geographical mile.
	100 1	2,3900	—— —— ——
	89 32	2,1731	—— —— ——

Shewing that a flexure takes place in the direction of the isoclinal lines, as represented in fig. 3—much at variance with the supposed uniformity of their curvature,—and with reference to r, a determined variation from the theory ($\tan. \delta = 2 \tan. \lambda$) in which r cannot exceed 2:—If we now refer to page 213 for the mean values of δ and λ; we can, from the above values of r and θ, compute more correct values than we have yet obtained of the latitude of the magnetic equator; thus

μ	Lat. of Mag. Equator.
° ′ ″	° ′ ″
80 6 47	+ 9 53 4
79 27 23	10 3 35
77 3 38	9 58 53

These values are no doubt very near the truth; the only doubt which can exist, is, whether we ought not to have rejected the observations at Kalehannary and Vadinatrum? If we had done so, the above 2d and 3d values would each be increased about two minutes.

Intensity Observations.

I have already mentioned that the intensity needles, employed for a great portion of this work, were constructed by myself, immediately before quitting Madras,—when I had observed with them for about 30 or 40 days only. During this time, no perceptible alteration in the magnetic intensity* of either of them having taken place, I determined to trust to their invariability†—or rather to give the results, if on my return to Madras it appeared that the needles had not varied;—and the needles constructed by Mr. Caldecott, had not been in use for a day previously to my quitting Trivandrum. Under these circumstances, it will naturally be expected that our intensity observations are of little worth; particularly since the observations have been made over a tract of country, where from theory we know that an almost invariable intensity must prevail;

* The needles of this construction employed in England for measuring magnetic intensity, have generally been found to part with their intensity, during the first two years after being magnetized.

† The two needles to which this remark belongs, remained suspended in their boxes during this time: had they been handled even, experience since shews that a difference would probably have been obtained.

and that, to trace the law of its variation under these circumstances, observations of far more than ordinary accuracy should be employed. I had however other motives in view in making these observations than that of discovering from them the *law* of magnetic intensity. My object was, *not* to discover the law, but—assuming the law according to theory—how far it was transgressed by incidental or local causes: for, with regard to the latter, our track along the Coromandel coast, surrounded by extensive sandy plains, would form a fair field for exhibiting the effect of local disturbances, when contrasted with the vast granitic formations and elevations to be met with in and near to Travancore and along the Western coast generally.

With thus much by way of explanation, I will now lay before the reader the whole of the observations, even those which I shall eventually propose to reject, in order, that no more, or less importance may be attached to them, than they are fairly entitled to. I will here mention one trifling circumstance with regard to Mr. Caldecott's needles; namely, that, with a view to try if their intensities might not be rendered at once invariable, before leaving Trivandrum I submitted each of them to rather rough usage by hard friction. The effect of this was, that a diminution of intensity ensued at once—to the amount of about 20 seconds in performing 100 vibrations. How far this might be carried, is a matter of interest for which I may not pause here, save to remark, that, as far as my experience goes, a needle may by this means at once be brought to a fixed intensity; of which more presently. It only remains for me to add, that the same observers and the same stations as those mentioned in the dip observations, apply to these.

Corrections to be applied to the Intensity Observations.

The corrections to be applied to the observed time of one of these needles, performing 100 vibrations, are three in number.

1st.—On account of R the rate of the chronometer; which renders necessary the correction

$$\text{rate} = I - \left(I \times \frac{86400}{86400 + R}\right)$$

2d.—*On account of arc.* To reduce the time of vibration performed in a circular arc commencing from A°, and terminating at a°, to that which would have been noted had the vibrations been performed in an infinitely small circular, or a cycloidal arc, the correction is

$$\text{corr. for } arc = + I \times \frac{\text{sin. }(A + a).\ \text{sin. }(A - a)}{32\ M\ (\text{log. sin. } A - \text{log. sin. } a)}$$

where M = the logarithmic modulus = 2,302585; and A and a, throughout—have always been 20° and $6\frac{1}{2}$° respectively; or correction for arc = + (I ×,0022).

3d.—*On account of temperature.*—It being found that a magnetized needle exhibits a greater degree of intensity in cold than in warm weather, it is necessary to render the observations comparable—that they should either all be made at the same temperature, or that, if the temperature vary, a correction proportionate thereto should be employed: for this purpose I have lately made several observations with the three needles employed by myself, at temperatures between 70° and 80°; by observing in a cool room of uniform temperature, and afterwards in one with a low roof with a higher temperature, when the following rates of alteration were observed:

No. observations.	Needle No. 1 Faht. therm.	Needle No. 1 Time of 100 vib.	Needle No. 2 Faht. therm.	Needle No. 2 Time of 100 vib.	Needle No. 3 Faht. therm.	Needle No. 3 Time of 100 vib.
	°	s	°	s	°	s
from 3	$t' + 8{,}0$	$I_{,} + 0{,}37$	$t' + 14\ 5$	$I_{,} + 0{,}90$	$t' + 8.0$	$I_{,,,} + 0\ 65$
——	$t' + 11{,}0$	$I_{,} + {,}70$	$t' + 10\ 8$	$I_{,,} + 0.60$	$t' + 8.8$	$I_{,,,} + 0{,}27$
——	$t' + 11{,}4$	$I_{,} + {,}57$	$t' + 12.3$	$I_{,,} + 0{,}70$	$t + 9.1$	$I_{,,,} + 0{,}44$

where $I_{,}$ $I_{,,}$ $I_{,,,}$ represent the time of performing 100 vibrations at the lower temperature (t')—If I represent the time of performing 100 vibrations at the standard temperature t; and $I_{,}$ that of performing the same at any other temperature t' then the correction

$$I - I = a\,I\,(t - t')$$

$$\text{or} \quad a = \frac{I - I_{,}}{I\,(t - t')}$$

In which $I_{,}$ $I_{,,}$ $I_{,,,}$ were $\overset{s}{282}$, $\overset{s}{312}$, and $\overset{s}{277}$ respectively; whence

$a = {,}00018$ for needle No. 1.

$= {,}00019$ —— No. 2.

$= {,}00019$ —— No. 3.

This near and unusual agreement *inter se*, arising no doubt from my not having employed artificial heat (as has been usual in observations of this nature), has induced me to suppose that the remaining two needles require the same correction, which consequently has been applied in the reductions (Table III). This premised, we may now proceed to the

Discussion of the Intensity Observations.

In the examination of the intensity observations, it will be found convenient and necessary, to divide them into three several classes, and to discuss the observations with each needle—cylinder rather—in each class separately; thus—

Class 1st.—*Observations made from Madras to Trivandrum and back again.*

— 2d.—*Observations made from Tellicherry to Trivandrum.*

— 3d.—*Observations made from Madras to Ongole and back again.*

Class I.

If we now attentively examine Table II, in which this arrangement has been made for the first class of the cylinder T. G. T. No. 1, we perceive that the numbers in the column "difference," decrease pretty uniformly, in something like a geometrical progression, corresponding to an arithmetical advance of the time,—until at *Nagracoil*, we find that for nearly a month, no alteration had taken place in its intensity. If we examine the observations with cylinder T. G. T. No. 2, we find that precisely the same circumstance occurs; and on examining T. G. T. No. 3, it appears, that—with the exception of a difference of 10,00 seconds caused by the cylinder having been let fall,—during nine weeks its intensity remained unchanged. If then it be admitted for cylinders Nos. 1 and 2, that they had arrived at a fixed state of intensity on the 25th August; and that No. 3 had done so on the 2d August, it only remains, that we should cancel the observations made previously to these dates, and adopt those made subsequent thereto. One circumstance, however, must be noticed with regard to cylinders Nos. 1 and 2, namely—that the observations at eight stations made in the course of our *onward* march, (between Negapatam and Palamcottah), have purposely been omitted; the cylinders when at these places not having arrived at a fixed state of intensity, the observations must necessarily be given up. With regard to the two cylinders constructed by Mr. Caldecott, I have already mentioned that I had submitted them to rather rough usage; by which their intensities had at once been reduced to the amount of several seconds for performing 100 vibrations; my intention was to bring them at once to a fixed state of intensity, for I can state with considerable confidence, that *when a needle is magnetized to saturation, its loss of magnetic intensity is due alone to the necessary violence employed in its use.* I have employed a cylinder which was magnetized to saturation for a month—not touching it—without its having parted with any portion of its magnetism; but on applying the armature, and then again vibrating it, a change of several seconds has immediately resulted. In confirmation of these views, it will be noticed that on the return of cylinders J. C. 1 and 2 to Trivandrum, after an absence of ten weeks, in which they had travelled over 1200 miles,

No. 1 had varied its intensity	+ $\overset{s}{0.40}$	in performing
2 —— —— ——	— 0.87	100 vibrations.

TABLE II.

CLASS 1st—Cylinder T. G. T. No. 1.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80° Temperature	Difference.
1837			s	m s	°	s	s	s	s	s
July	18	Madras	259,46	+ 0 8,0	85,6	—,572	— ,024	— ,275	259,14	— 14,84
October	16	,,	274,23	— 0 21,5	85,5	,604	+ ,070	,286	273,98	
July	24	Sadras.	262,80	— 0 11,0	87,4	,579	+ ,033	,368	262,62	9,98
October	14	,,	272,87	— 0 21,5	85,0	,601	+ ,068	,259	272,60	
October	13	Allumparva	274,53	— 0 21,5	89,0	,604	+ ,068	,468	274,46	
July	27	Pondicherry	266,56	— 0 11,0	87,7	,587	+ ,032	,388	266,39	7,65
October	12	,,	274,13	— 0 21,5	88,5	,604	+ ,068	,443	274,04	
July	31	Porto Novo	268,30	— 0 12,0	89,5	,591	+ ,039	,484	268,23	5,52
October	11	,,	273,80	— 0 21,5	89,4	,604	+ ,068	,486	273,75	
August	2	Sheally	269,53	— 0 12,0	86,0	,593	+ ,039	,306	269,38	5,12
October	10	,,	274,87	— 0 21,5	83,2	,605	+ ,068	,166	274,50	
August	7	Tranquebar	270,97	+ 3 49,0	92,8	,596	— ,689	,656	270,36	
	10	,,	270,20	— 0 12,0	87,6	,595	+ ,039	,389	270,03	4,00
October	7	,,	274,20	— 0 21,5	91,5	,604	+ ,068	,540	274,20	
August	11	Negapatam	270,70	+ 3 49,0	92,4	,596	— ,715	,632	270,02	3,45
October	3	,,	273,97	— 0 21,5	80,2	,603	+ ,068	,010	273,47	

CLASS 1st.—Cylinder T. G. T. No. 1 *continued.*

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for			Time of 100 vibrs. at 80° Temperature	Difference.
						Arc.	Rate.	Temp.		
1837			s	s m	°	s	s	s	s	s
August	24	Pallamcottah....	267,50	+ 3 49,0	95,5	—,589	— ,709	+,775	266,98 }	* 8,55
September	22	"	275,67	— 0 21,5	87,6	,607	+ ,068	,400	275,53 }	or 3,20 perhaps.
August	25	Nagracoil.......	275,10	+ 3 48,0	86,7	,606	— ,724	,353	274,12 }	0,29
September	21	"	274,63	— 0 21,5	86,2	,605	+ ,064	,321	274,41 }	
August	28	Trivandrum	275,57	+ 3 46,5	84,7	,607	— ,709	,245	274,50 }	— 0,51
September	16	"	274,20	— 0 20,5	86,4	,604	+ ,064	,332	273,99 }	
September	26	Teutocorin	274,77	— 0 20,0	85,8	,605	+ ,068	,303	274,54	
September	30	Paumban...........	274,47	— 0 20,0	87,6	,605	+ ,068	,395	274,33	

* The observation on the 24th August is from the mean of two sets; thus—
In the outer verandah: time of 100 vibrations 267,60*s*:—removed to a distance of 30 or 40 yards into a cocoanut tope the time of 100 vibrs. = 267*s*,41.
Notwithstanding this agreement, I think we must have counted 98 vibrations only instead of 100, which is a mistake very easily committed.
The other observation (that on 22d September), was made under the verandah of a house in the Fort, near to the commanding officer's quarters, and three-fourths of a mile from the above.

CLASS Ist—Cylinder T. G. T. No. 2.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermo-meter.	Correction for			Time of 100 vibrs. at 80° Temperature	Differ-ence.
						Arc.	Rate.	Temp.		
1837			s	m s	°	s	s	s	s	s
July	18	Madras	271,42	+ 0 8,0	85,5	—,599	— ,035	+ ,281	271,14	20,27
October	16	,,	291,70	— 0 21,5	85,0	,641	+ ,072	,277	291,41	
July	24	Sadras	273,53	— 0 11,0	87,5	,603	+ ,035	,392	273,35	17,30
October	14	,,	291,00	— 0 21,5	84,0	,641	+ ,072	,221	290,65	
do	13	Allumparva	292,03	— 0 21,5	88,8	,644	+ ,072	,484	291,94	
July	27	Pondicherry	282,26	— 0 11,0	87,4	,623	+ ,036	,396	282,07	9,66
October	12	,,	291,83	— 0 21,5	88,6	,644	+ ,072	,475	291,73	
July	31	Porto Novo	281,50	— 0 12,0	88,6	,621	+ ,039	,460	281,38	10,35
October	11	,,	291,66	— 0 21,5	90,6	,642	+ ,072	,586	291,68	
August	2	Sheally	285,65	— 0 12,0	86,4	,629	+ ,039	,347	285,41	6,33
October	10	,,	292,10	— 0 21,5	83,8	,644	+ ,072	,211	291,74	
August	7	Tranquebar	284,93	+ 3 49,0	92,4	,628	— ,758	,667	284,13	
,,	10	,,	284,53	— 0 12,0	87,3	,627	+ ,039	,394	284,34	8,23
October	7	,,	292,87	— 0 21,5	91,2	,644	+ ,072	,160	292,46	
August	11	Negapatam	285,33	+ 3 49,0	92,5	,629	— ,759	,672	284,61	6,97
October	3	,,	292,13	— 0 21,5	80,4	,643	+ ,072	,022	291,58	

CLASS 1st.—Cylinder T. G. T. No. 2 *continued.*

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80° Temperature	Difference.
1837			s	m s	°	s	s	s	s	s
August	24	Pallamcottah	*286,73	+ 3 49,0	90,7	—,633	— ,760	+,576	285,91 }	
September	22	”	295,03	— 0 21,5	87,6	,65	+ ,073	,423	294,87 }	8,96
August	25	Nagracoil	293 60	+ 3 48,0	86,7	,647	— ,774	,372	292,55 }	
September	21	”	293,57	— 0 20,5	86,4	,646	+ ,070	,356	293,35 }	0,80
August	28	Trivandrum	295,47	+ 3 46,5	84,7	,651	— ,774	,264	294,31 }	
September	16	”	293,80	— 0 20,5	86,3	,647	+ ,070	,351	293,57 }	—0,74
September	26	Teutocorin	293,97	— 0 20,0	85,6	,646	+ ,068	,312	293,70	
September	30	Paumban	292,07	— 0 20,0	85,8	,643	+ ,067	,322	291,82	

* After making this observatiou I let the needle fall from my hand to the ground.

CLASS 1st.—Cylinder T. G. T. No. 3.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80. Temperature	Difference.
1837			s	m s	"	s	•	s	s	s
July	18	Madras........	245,82	+ 0 8,0	86,0	—,542	— ,022	+ ,281	245,54	20,54
October	16	„	266,30	— 0 21,5	86,0	,582	+ ,066	,301	266,08	
July	24	Sadras	247,80	— 0 11,0	86,3	,546	+ ,032	,297	247,58	18,02
October	14	„	265,83	— 0 21,5	85,7	,583	+ ,066	,284	265,60	
October	13	Allumparva	266,67	— 0 21,5	83,7	,584	+ ,066	,445	266,60	
July	27	Pondicherry	250,49	— 0 11,0	87,8	,551	+ ,032	,370	250,34	15,87
October	12	„	266,27	— 0 21,5	89,0	,584	+ ,066	,455	266,21	
July	31	Porto Novo	253,75	— 0 12,0	88,8	,557	+ ,035	,424	253,65	13,78
October	11	„	267,27	— 0 21,5	93,0	,564	+ ,067	,656	267,43	
August	2	Sheally....	256,80	— 0 12,0	87,3	,563	+ ,036	,356	256,63	9,78
October	10	„	266,70	— 0 21,5	84,4	,583	+ ,067	,221	266,41	
August	7	Tranquebar....	257,00	+ 3 49,0	91,7	,560	— ,678	,566	256,43	11,80
„	10	„	255,53	— 0 12,0	87,1	,559	+ ,036	,345	255,35	
October	7	„	267,60	— 0 21,5	92,0	,585	+ ,067	,611	267,69	
August	11	Negapatam....	257,77	+ 3 49,0	93,0	,563	— ,684	,637	257,16	11,35
October	3	„	269,03	— 0 21,5	80,0	,584	+ ,066	,000	268,51	

Class 1st.—Cylinder T. G. T. No. 3.

Date.		Place.	Obs time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80. Temperature	Difference.
1837			s	m s		s	s	s	s	
August	13	Munargoody....	260,43	+ 3 49,0	88,8	—,569	— ,670	+ ,431	259,63	
,,	14	Puttoocottah	260,83	+ 3 49,0	88,0	,569	— ,670	,395	259,99	
,,	15	Munamelegoody	259,90	+ 3 49,0	85,8	,568	— ,688	,282	258,93	
,,	16	Kalehennary....	259,90	+ 3 49,0	87,6	,568	— ,688	,371	259,91	
,,	18	Ramnad....	260,43	+ 3 49,0	88,8	,569	— ,679	,434	259,61	
September	30	Paumban....	267,63	— 0 20,0	84,4	,581	+ ,064	,222	267,33	
August	20	Carryshandy....	260,57	+ 3 49,0	93,8	,569	— ,689	,686	260,00	
,,	21	Vadinatrum....	260,67	+ 3 49,0	96,0	,569	— ,689	,793	260,20	
,,	22	Powani	260,53	+ 3 49,0	89,8	,569	— ,679	,486	259,76	
September	26	Teutocorin	266,93	— 0 20,0	85,8	,582	— ,064	,294	266,71	
August	21	Pallamcottah....	256,13	+ 3 49,0	94,6	,561	— ,682	,713	255,60	13,87
September	22	———	269,60	— 0 21,5	87,7	,590	+ ,066	,395	269,47	
August	25	Nagracoil....	258,47	+ 3 48,0	86,6	,567	— ,684	,323	257,55	12,36
September	21	———	269,07	— 0 20,5	87,2	,589	+ ,065	,368	269,91	
August	28	Trivandrum	* 257,47	+ 3 46,5	84,7	,569	— ,684	,234	258,45	10,62
September	13	———	269,27	— 0 20,5	86,3	,589	+ ,065	,322	269,07	

* Immediately after marking this observation the cylinder accidentally dropped from my hand upon the ground, when it appeared, that an alteration in the time of making 100 vibrations to the amount of 10,00 seconds had taken place.

CLASS Ist. Cylinder J. C. No. 1.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80. Temperature	Difference.
1837			s	m s	°		s	s	s	s
September	16	Trivandrum	204.67	— 0 1,0	86,6	— 452	0.000	,256	204,47 }	
November	22	"	204 37	0.0	84,0	,452	0,000	,156	204,07 }	—0,40
September	21	Nagracoil	203·37	— 20,5	86,5	,448	+ ,050	,251	203,22	
"	22	Pallamcottah	204.33	— 21,5	87,7	,451	.050	,297	204,23	
"	26	Teutocorin	202.93	— 21,5	85,0	,447	,050	,193	202,73	
"	30	Paumban	202.40	— 21,5	88,4	,445	,050	,321	202 33	
October	3	Negapatam	202.13	— 21,5	82.7	,445	,050	,104	201 84	
"	7	Tranquebar	202.33	— 21,5	92.0	,445	,050	,460	202.40	
"	10	Sheally	202.37	— 21,5	86,6	,445	,050	,252	202,23	
"	11	Porto Novo	201.83	— 21,5	92,6	,445	,050	,482	201,92	
"	12	Pondicherry	202.10	— 21,5	89 6	,445	,050	,364	202,07	
"	13	Allumparva	203.13	— 21,5	90.0	,448	,050	,386	203,12	
"	14	Sadras	200.83	— 21,5	86,0	,442	,050	,229	200,67	
"	16	Madras	202.12	— 21,5	86,2	,445	,050	,240	201,97	

CLASS Ist. Cylinder J. C. No. 2.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80. Temperature	Difference.
1837										
September	20	Trivandrum	278,17	— 0 1,0	86,6	—,613	0,000	+0,318	277,91 }	
November	12	"	279,18	0.0	83,9	,615	,000	,208	278 78 }	+ 0,87
September	21	Nagracoil	277,30	— 20,5	86,0	,611	+ ,066	,316	277,07	
"	22	Pallamcottah	278,23	— 21,5	88,4	,613	,069	,445	278,13	
"	26	Teutocorin	276,00	— 21,5	85,0	,608	,069	,262	275,72	
"	30	Paumban	278,43	— 21,5	88,4	,613	,069	,445	277,33	
October	3	Negapatam	278,67	— 21,5	82,6	,613	,069	,136	278,26	
"	7	Tranquebar	278,60	— 21,5	91,8	,613	,069	,627	278,68	
"	10	Sheally	279.70	— 21,5	85 6	,616	,069	,297	279,39	
"	11	Porto Novo	278,73	— 21,5	93,0	,613	,069	.690	278,88	
"	12	Pondicherry	279,00	— 21,5	89,6	,614	,069	.509	278,96	
"	13	Allumparva	279,50	— 21,5	90,0	,615	,069	,533	279,49	
"	14	Sadras	277,30	— 21,5	86 0	,611	.069	,315	277,09	
"	16	Madras	277,85	— 21,5	86,2	,612	.069	,325	277,64	

A few days after my arrival at Madras, having completed the observations of Class I., I despatched the cylinders in a banghy parcel for *Cochin*, where they were met by Mr. Caldecott, for the purpose of making the observations which follow. In comparing the times of performing 100 vibrations at Trivandrum now observed, with those obtained when I left there, it appears that the Cylinder T. G. T. No 1, had diminished its intensity* by about 6 seconds, and No. 2 had diminished 1,2 seconds† in performing 100 vibrations; a circumstance which could only be expected, on considering the rough usage to which, in all probability, parcels are subjected by the banghy runners; such however is not the case with the other cylinder (No. 3), nor with J. C. Nos. 1 and 2; these last no doubt owe their invariableness to the rough usage to which I had previously subjected them—having performed at once what otherwise would have been performed by degrees.—In addition to the two cylinders J. C. No. 1 and No. 2, Mr. Caldecott had now constructed a third: which appears to have arrived at a fixed state of intensity; since, during 27 days (in which observations of this class were being made) its intensity diminished only 0, 19*s*. for 100 vibrations: this cylinder differed from the other two, in its length only; a circumstance which arose from its extreme brittleness, by which one end (about ½ an inch) broke off, in polishing, after it had been tempered.

* It is somewhat curious, although quite accidental no doubt, that

		s	
No. 1	has lost altogether	20,68	in performing 100 vibrations.
2	—— ——	20,27	
3	—— ——	20,54	

† This decrease of intensity in No. 2 is I think rather chargeable to other causes.

CLASS 2D.—Cylinder J. C. No. 1.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Faht. Thermometer.	Correction for Arc.	Correction for Rate	Correction for Temp.	Time of 100 vibrs. at 80. Temperature	Difference.
1837			s	m s	°	s	s	s	s	
September	16	Trivandrum	204,67	— 0,1,0	86,6	,452	0,00	+ ,258	204,48	
November	22	,, ...	204,37	0,0,0	84,0	,452	,00	+ ,156	204,07	
December	5	,, ...	203,97	0,0,0	79.1	,450	,00	— ,036	203,48	
November	15	Quilon	205,47	0,0,0	83,0	,453	,00	+ ,117	205,14	
,,	13	Allepee....	205,37	0,0,0	79,7	,453	,00	— ,012	204,91	
,,	9	Balghatty....	203,71	0,0,0	80,3	,449	,00	+ ,012	203,28	
,,	6	Chetwaye....	204,36	0,0,0	82,7	,450	,00	+ ,105	204,02	
,,	5	Penaney..	201,96	0,0,0	82,5	,445	,00	+ ,096	201,62	
,,	4	Calicut..	202,80	0,0,0	84,7	,446	,00	+ ,181	202,54	
,,	1	Tellicherry....	203,49	0,0,0	82,2	,448	,00	+ ,083	203,13	

CLASS 2D.—Cylinder J. C. No. 2.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Faht. Thermometer.	Correction for Arc.	Correction for Rate	Correction for Temp.	Time of 100 vibrs. at 80. Temperature	Difference.
1837										
September	20	Trivandrum	278,17	— 0,1,0	86,6	,613	0,00	+ ,349	277.91	
November	22	,, ...	279,18	0,0,0	83,9	,615	,00	,208	278.78	
December	5	,, ...	279,28	0,0,0	79,5	,616	,00	— ,026	278.64	
November	15	Quilon....	280,99	0,0,0	83,1	,620	,00	+ ,165	280.54	
,,	13	Allepee....	280,79	0,0,0	76,0	,619	,00	— ,214	279.96	
,,	9	Balghatty	278,85	0,0,0	80,3	,614	,00	+ ,016	278.26	
,,	6	Chetwaye	279,55	0,0,0	82,3	,616	,00	+ ,122	279.06	
,,	5	Penaney....	278,81	0,0,0	82,6	,614	,00	+ ,138	278.34	
,,	4	Calicut....	279,28	0,0,0	84,9	,616	,00	+ ,261	278.93	
,,	1	Tellicherry....	279,91	0,6,0	84,7	,617	,00	+ ,250	279.55	

CLASS II, Cylinder J. C. No. 3.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80. Temperature	Difference.
1837			*s*	*m s*	°	*s*	*s*	*s*	*s*	
October	7	Trivandrum....................	211,91	— 0 0,0	—80.7	,473	0,00	+,029	214,47	
,,	26	,, ...	215.47	0,0	84,6	,475	,00	+,189	215,19	
November	22	,, ...	215,86	0,0	79,8	,475	,00	—,012	215,38	
December	5	,, ...	216,06	0,0	84,1	,475	,00	+,188	215,78	
November	15	Quilon........................	217,46	0,0	83,5	,479	,00	+,146	217,13	
,,	13	Allepee.....................	217.36	0,0	76 7	,479	,00	—,136	216,75	
,,	9	Balghatty....................	214,76	0,0	79,5	,473	,00	—,021	214,27	
,,	6	Chetwaye.....................	215,36	0,0	81,7	,474	,00	+,070	214,96	
,,	5	Penaney......................	214,57	0,0	83,0	,472	,00	+,123	214,23	
,,	4	Calicut......................	214,23	0,0	84,0	,471	,00	+,161	213,93	
,,	1	Tellicherry..................	214,60	0,0	83,7	,472	,00	+,152	214,28	

CLASS II, Cylinder T. G. T. No. 1.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80. Temperature	Difference.
1837										
September	16	Trivandrum....................	274,29	— 0,20,5	86,4	,604	+0,064	+,332	273,99	
November	22	,, ...	280,[illegible]8	0,0	84,9	,617	,000	+,261	279,83	
December	5	,, ...	280,08	0,0	80,0	,617	,000	+,000	279,47	
November	15	Quilon........................	281,38	0,0	82,7	,621	,000	+,144	280,91	
,,	13	Allepee......................	281,58	0,0	77,4	,622	,000	—,138	280.82	
,,	9	Balghatty....................	279.25	0,0	82,0	,615	,000	+,106	278.75	
,,	6	Chetwaye.....................	280 31	0,0	80,8	,618	,000	+,043	279.74	
,,	5	Penaney......................	278,78	0,0	83,3	,615	,000	+,173	278.34	
,,	4	Calicut......................	278,56	0,0	87,0	,614	,000	+,370	278,34	
,,	1	Tellicherry..................	279,11	0,0	82,9	,615	,000	+,155	278,65	

CLASS IId.—Cylinder T. G. T. No. 2.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80. Temperature	Difference.
1837			s	m s	°	s	s	s	s	
September	16	Trivandrum	293.80	− 0,20,5	86,3	,647	+ 0,070	+ ,351	293,57	
November	22	”	295.09	0, 0,0	85,0	,648	,000	+ ,275	294,72	
December	5	”	293,79	0,0	80,0	,615	.000	,000	293,15	
November	15	Quilon	294,59	0,0	82,0	,616	,000	+ ,112	294,06	
do.	13	Allepee	294,99	0,0	78,6	,648	,000	− ,075	294,26	
do.	9	Balghatty	292.46	0,0	83,3	,611	,000	+ ,182	292,01	
do.	6	Chetwaye	293,03	0.0	81,1	,612	,000	+ ,061	292,45	
do.	5	Penaney	292,86	0,0	83,0	,612	,000	+ ,167	292,38	
do.	4	Calicut	293,29	0.0	83,7	,613	,000	+ ,205	292,86	
do.	1	Tellicherry	294,24	0,0	82,8	,616	,000	+ ,156	293,75	

CLASS IId.—Cylinder T. G. T. No. 3.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80. Temperature	Difference.
September	13	Trivandrum	269,27	− 0,20,5	86,3	,589	+ ,065	+ ,322	269,07	
November	22	”	268,28	0,0	85,2	,591	,000	+ ,261	267,96	
December	5	”	267,58	0,0	79,9	,589	,000	− ,005	266,99	
November	15	Quilon	269,78	0,0	82,0	,593	,000	+ ,102	269,29	
do.	13	Allepee	269,88	0,0	79.5	,594	,000	− ,026	269,26	
do.	9	Balghatty	267,41	0,0	83,4	,589	,000	+ ,170	267,00	
do.	6	Chetwaye	267,95	0 0	80,8	,590	,000	+ ,407	267,77	
do.	5	Penaney	267,61	0,0	82,9	,589	,000	+ ,148	267,17	
do.	4	Calicut	266,88	0,0	83,7	,587	,000	+ ,185	266,48	
do.	1	Tellicherry	267,73	0,0	82,7	,589	,000	+ ,136	267,28	

N. B.—The observations at Tellicherry were made in a thatched room, on the bastion, behind the master attendant's house.

CLASS III.

Immediately after making the above observations, which were performed altogether by Mr. Caldecott, he despatched the cylinders to Madras, for the purpose of enabling me to make the observations to the north of this place; the carriage of them was necessarily effected as before by the baughy runners; save that Mr. Caldecott had taken the precaution to place the cylinders in grooves cut in a little box, made on purpose for their reception; and the whole was tightly secured by cotton. Notwithstanding this precaution, on the arrival of the box at Madras, the cylinders were all found huddled together in one corner of the box, the insufficient quantity of cotton which remained, allowing them to play about in any manner they pleased; it was in fact but too evident that the box had been opened to ascertain its contents, and had not been packed again with anything like care. Thus circumstanced, the needles, which had necessarily lost a considerable degree of intensity, were now employed during two months by my assistant *Tannyachellum*, by way of learning; when, finding that during this time they bore rough handling without losing any portion of their intensity, on the 21st April I despatched them by *Tannyachellum* to Ongole, when the following observations were made :—

CLASS IIId.—Cylinder T. G. T., No. 1.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80 Temperature	Mean.
			s	m s	°	s	s	s	s	s
1838 April	20	Madras	283,00	— 0,18,5	86,0	— ,623	+ ,060	+ ,060	282,50	282,37
June	16	,,	282,30	— 0,18,5	89,5	,622	,060	+ ,509	282,25	
1839 January	17	,,	282 78	— 0, 0,5	79,0	,623	,000	— ,053	282,10	
1838 April	29	Poodaway	283,33	— 0,18,5	95,0	,624	+ ,060	+ ,807	283,57	284,03
June	7	,,	284,43	— 18,5	9 ,7	,626	,060	,632	284,50	
May	7	Sooloorpet	283,40	— 18,5	101,0	,621	,060	1,184	284,02	284,85
June	3	,,	285,67	— 18,5	100,5	,629	,060	0,572	285,67	
May	9	Woogilly	283,43	— 18,5	99,5	,624	,060	,512	283,38	283,87
June	1	,,	281,55	— 18,5	97,0	,626	,060	,379	284,36	
May	12	Nellore	283,53	— 18,5	102,5	,621	,060	,672	283,64	284,57
do.	29	,,	285,67	— 18,5	87,5	,629	,060	,406	285,51	
do.	14	Alloor	284,20	— 18,5	106,7	,625	,060	1,441	285,08	285,53
do.	27	,,	285,60	— 18,5	97,5	,628	,060	0,955	285,99	
do.	16	Ramapatam	284,53	— 18,5	108,5	,626	,060	1,542	285,51	285,51
do.	23	,,	285,50	— 18,5	90,7	,628	,060	0,578	285,51	
do.	19	Ongole	282,93	— 18,5	96,7	,623	,060	,899	283,27	283,88
do.	20	,,	281,17	— 18,5	96,0	,625	,060	,866	284,49	

CLASS IIId.—Cylinder T. G. T., No. 2.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80 Temperature	Mean.
1838			s	m s	°	s	s	s	s	s
April	20	Madras	312,93	— 0,18,5	85,2	— ,688	+ ,067	+ ,312	312,62 }	312,31
June	16	,,	312,05	— 0,18,5	90,0	— ,686	,067	,580	312,01 }	
1839 January	17	,,	311,47	— 0, 0,5	85,0	,685	,067	,282	311,13	
1838 April	29	Poodaway	312,40	— 0,18,5	93,5	,687	,067	,786	312,57 }	312,86
June	7	,,	313,07	18,5	91,7	,688	,067	,697	313,15 }	
May	7	Sooloorpet	314,57	18,5	102,0	,692	,067	1,375	315,32 }	315,18
June	3	,,	314,10	18,5	105,0	,690	,067	1,562	315,01 }	
May	9	Woogilly	311,87	18,5	104,0	,686	,067	1,378	312,63 }	313,49
June	1	,,	313,93	18,5	97,0	,690	,067	1,039	314,35 }	
May	12	Nellore	313,00	18,5	102,5	,688	,067	1,326	313,71 }	313,37
do.	29	,,	313,17	18,5	88,0	,688	,067	0,178	313,03 }	
do.	14	Alloor	313,70	18,5	106,0	,689	,067	1,578	314,66 }	314,80
do.	27	,,	314,50	18,5	97,0	,691	,067	1,057	314,93 }	
do.	16	Ramapatam	313,60	18,5	106,5	,689	,067	1,598	314,58 }	314,35
do.	23	,,	314,20	18,5	90,7	,690	,067	0,655	314,13 }	
do.	19	Ongole	314,10	18,5	97,0	,690	,067	1,045	314,52 }	313,97
do.	20	,,	313,10	18,5	96,0	,688	,067	0,950	313,43 }	

CLASS IIId.—Cylinder T. G. T. No. 3.

Date.		Place.	Obs. time of 100 vibrs.	Rate of Chronometer	Thermometer.	Correction for Arc.	Correction for Rate.	Correction for Temp.	Time of 100 vibrs. at 80 Temperature	Mean.
1838			s	m s		s	s	s	s	s
April	20	Madras	277,10	— 0,18,5	85,0	— ,610	+ ,058	+ ,263	276,81 }	276,96
June	17	,,	277,13	— 0,18,5	90,5	,611	,058	,554	277,13 }	
1839 January	17	,,	277,70	— ,0 0,5	85,1	,612	,058	,268	277,41	
1838 April	29	Poodaway	277,77	— 18,5	95,0	,612	,058	,792	278,01 }	278,36
June	7	,,	278,67	18,5	91,5	,614	,058	,609	278,72 }	
May	7	Sooloorpet	277,40	18,5	102,0	,611	,058	1,162	278,01 }	279,13
June	3	,,	279,40	18,5	106,7	,616	,058	1,418	280,26 }	
May	9	Woogilly	277,05	18,5	102,0	,610	,058	1,157	277,65 }	278,50
June	1	,,	279,00	18,5	97,0	,615	,058	,901	279,34 }	
May	12	Nellore	278,31	18,5	102,5	,612	,058	1,190	278,95 }	278,66
do.	29	,,	278,50	18,5	88,0	,614	,058	,421	278,37 }	
do.	14	Alloor	279,95	18,5	106,0	,617	,058	1,383	280,77 }	279,95
do.	27	,,	278,80	18,5	96,5	,615	,058	,872	279,12 }	
do.	16	Ramapatam	278,10	18,5	105,5	,612	,058	1,320	278,87 }	279,03
do.	23	,,	279,20	18,5	90,5	,615	,058	,557	279,20 }	
do.	19	Ongole	278,21	18,5	97,5	,612	,058	,923	278,58 }	279,54
do.	20	,,	280,15	18,5	97,0	,617	,058	,905	280,50 }	

To deduce from these values of the times occupied by each cylinder to perform 100 vibrations, the relative horizontal magnetic intensities at the several places: let T represent the time of any needle performing 100 horizontal vibrations at *Madras*; and T′, the time occupied by the same needle, to perform 100 vibrations at any other place, and let h, and h' represent the horizontal intensities at those places: then we get

$$\frac{h}{h'} = \left(\frac{T'}{T}\right)^2.$$

Applying this formula to the *Madras* and *Trivandrum* observations, and putting $h = 1$ we have

	T.G.T. 1.	T.G.T. 2.	T.G.T. 3.	J. C. 1.	J. C. 2.
Madras........	273°,98	291°,41	266,08	201,97	277,64
Trivandrum....	274.50	294.31	———	204,47	277,91
	273,99	293,57	269,07	204,07	278,78
h' = ...	0,998032	0,982860	0,977899	0,977608	0,994905

Mean value of h' = ,98626

Assuming h' as just found, if we now compare the observations made between *Vadinatrum* and *Tellicherry* with those made at *Trivandrum*; and (recollecting that $h = 1$,) compare the observations at the remaining stations with those made at *Madras*, we get altogether as follows:—

TABLE IV.

A table of the observed horizontal Magnetic force relative to Madras assumed = 1.

Place.	T. G. T. 1	T. G. T. 2	T. G. T. 3	J. C. 1.	J. C. 2	J. C. 3	Mean.
Ongole	0,9894	0,9894	0,9816	......	......	......	0,9868
Ramapatam	,9781	,9870	,9852	......	......	......	,9834
Alloor	,9780	,9842	,9790	......	......	......	,9804
Nellore	,9846	,9933	,9878	......	......	......	,9886
Woogilly	,9895	,9925	,9890	......	......	......	,9903
Sooloorpet	,9827	,9819	,9845	......	......	......	,9830
Poodaway	,9883	,9965	,9900	......	......	......	,9913
Madras	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Sadras	1,0101	,0052	1,0036	1,0130	,0040	......	1,0072
Allumparva	0,9965	,9964	,9961	,9887	,9868	......	0,9929
Pondicherry	0,9996	,9978	,9990	,9990	,9906	......	,9972
Porto Novo	1,0017	,9981	,9899	1,0005	,9911	......	,9962
Sheally	0,9962	,9977	,9893	0,9974	,9875	......	,9936
Tranquebar	0,9984	,9928	,9887	0,9958	,9926	......	,9937
Negapatam	1,0037	,9988	,9797	1,0012	,9956	......	,9958
Manargoody	......	......	,9773	......	......	......	,9773

TABLE IV—*continued.*

A table of the observed horizontal Magnetic force relative to Madras assumed = 1.

Place.	T. G. T. 1	T. G. T. 2	T. G. T. 3	J. C. 1.	J. C. 2	J. C. 3	Mean.
Puttoocottah	......	......	,9746	......	......	......	,9746
Munamelegoody	......	......	,9826	......	......	......	,9826
Kalehennary	......	......	,9820	......	......	......	,9820
Ramnad	......	......	,9775	......	......	......	,9775
Paumban	,9857	,9972	,9952	,9964	1,0023	......	,9953
Carryshandy	......	......	,9745	......	......	......	,9745
Vadinatrum	......	......	,9730	......	......	......	,9730
Powani	......	......	,9763	......	......	......	,9763
Teutocorin	,9842	,9854	1,0038	1,0021	1,0020	......	,9955
Pallamcottah	,9888	,9776	,9970	,9366	,9847	......	,9869
Nagracoil	,9862	,9877	,9866	,9965	,9923	......	,9898
Trivandrum	,9771	,9863	,9863	0,9863	,9863	,9863	,9863
Quilon	,9774	,9854	,9685	,9824	,9739	,9695	,9762
Allepee	,9780	,9840	,9687	,9801	,9780	,9729	,9769
Balghatty	,9926	,9993	,9844	,9959	,9899	,9956	.9929
Chetwaye	,9856	,9963	,9840	,9887	,9843	,9892	,9880
Penaney	,9956	,9967	,9839	1,0123	,9894	,9960	,9956
Calicut	,9958	,9935	,9890	1,0032	,9852	,9987	,9942
Tellicherry	,9934	,9875	.9831	0,9974	,9808	,9955	,9896

These results appear, on the whole, as accordant as results from intensity observations generally come; for, independent of the known corrections and unavoidable errors which occur to observations of this nature, there are without doubt others of whose disposition we are ignorant; a fact, that will be rendered sufficiently obvious by consulting the foregoing observations, in which the greatest error of observation from *known causes*, I estimate can never amount to 4-tenths of a second of time; under these circumstances it will be turning the above results to the best account, if we now deduce the intensity of the magnetic equator; for, thus employed, we may fairly hope to get rid of errors of every kind. To arrive at the most accurate result, we must here have recourse to theory; and although the theory that the tangent of the dip is equal to twice the tangent of the magnetic latitude ($tan.\ \delta = 2\ tan.\ \lambda$) is derived from principles which appear, all circumstances considered, to be not strictly true; still, for the small space over which we have occasion to employ it, and that only in a differential sense, its accuracy is fully equal, and indeed superior, to our wants. If to the above formula we add, that, $h = A \cos. \lambda$, where A represents the *total* magnetic force; we arrive, after a little reduction, at the expression

$$h = 2\,A \sqrt{\frac{1}{3 + \sec.^2 \delta}}\ ;$$

from which we will now compute the

Total intensity of the Magnetic force at the Magnetic Equator, horizontal force at Madras = 1.

Place.	Observed values of A.	Mean value.	Difference.
Ongole.............	0,9920	0,9921	— ,0001
Ramapatam..........	,9879	....	— ,0042
Alloor..............	,9845	....	— ,0076
Nellore......	,9922	....	+ ,0001
Woojilly...........	,9933	....	+ ,0012
Sooloorpet...........	,9856	....	— ,0065
Poodaway..............	,9933	....	+ ,0012
Madras.................	1,0019	....	+ ,0098
Sadras................	,0082	....	+ ,0161
Allumparva..........	0,9938	....	+ ,0017
Pondicherry...........	,9980	....	+ ,0059
Porto Novo...... ...	,9966	....	+ ,0045
Sheally......... ...	,9939	....	+ ,0018
Tranquebar....	,9939	....	+ ,0018

Place.	Observed values of A.	Mean value.	Difference.
Negapatam...........	,9959	,09921	+ ,0038
Manargoody...........	,9774		
Puttoocottah........	,9747		
Munamelegoody.....	,9826		
Kalhennary,.........	,9821		
Ramnad............	,9775		
Paumban.......	,9953	....	+ ,0032
Carryshandy.... ...	,9748		
Vadinatram.........	,9730		
Powani.............	,9763		
Teutocorin..........	,9958	....	+ ,0037
Palamcottah	,9872	....	— ,0049
Nagracoil...........	,9898	... .	— ,0023
Trivandrum....	,9867	....	— ,0054
Quilon..............	,9765	....	— ,0156
Allepee................	,9771	....	— ,0150
Balghatty.......	,9929	....	+ ,0008
Chetwaye	,9882	....	— ,0039
Penaney..	,9958	....	+ ,0037
Calicut.............	,9946	....	+ ,0025
Tellicherry.........	.9901	....	— ,0020

If to each of the above values we were to give a weight proportionate to the number of cylinders employed, we should obtain a mean value possessing the least probable error of observation; but, since in this case the errors due to local causes would not be fairly dealt by, it becomes a question—if a more correct mean value would not be attained, by taking the mean without reference to the number of observations employed; to pursue a middle course, however, we may safely give

to 1 observation a weight 1
— 3 or 4 —— —— 2
and — 5 or 6 —— —— 3

(when, assuming the horizontal intensity at Madras = 1.)

The total magnetic force at the magnetic equator = ,9906
or, rejecting the observations at eight stations made *only* with cylinder T. G. T. No. 3, we get the horizontal intensity of the magnetic equator = ,9921 :—On comparing this with the several constituent values, we obtain the column " difference ;" exhibiting the amount of error of observation, mixed up with the effect of local disturbances; the largest of these (that at Sadras), might possibly be accounted for by

the granitic formations there met with (the Sadras hills), but *if so,* Palamcottah and Nagracoil (at which places similar but larger causes for disturbance exist) ought to shew the same; whereas they exhibit a very small, but opposite, tendency. Or it would appear on the whole, *that the distribution of magnetic intensity in Southern India is but little interfered with by local causes;* and, with reference to Madras, that the location chosen for making the observations exhibits an intensity in excess, to the amount of 1,0098 to 1.

Assuming this, we will now compare the magnetic intensity of Madras, and of the magnetic equator with that of London; for which purpose we have the following observations made with the two intensity cylinders belonging to Captain D. Bethune, already adverted to at the commencement of this paper. The observations in London were, I presume, made by Captain Bethune, whereas those at Madras in 1837 were made by Capt. B. and myself conjointly, and those in 1839 by myself alone.

Mean time occupied by Cylinder No. 3 × and No. 3 in making 10 vibrations, at the temperature of 60°.

Date.	at Madras. No. 3 ×	at Madras. No. 3	in London. No. 3 ×	in London. No. 3
			s	s
In the year 1835			442.76	461.96
1837.	s	s		
April 30 } May 3 }	300.30	309.74		
1839.				
Jan. 29	303.26	310.83		

A mere glance at these numbers, shews that one, if not both of the cylinders, had diminished its intensity at the time of making the first observations at Madras; and that after twenty-one months (when the second observations were made) they had still further diminished their intensities No. 3 ×, by 2.96*s* and No. 3, by 1.09*s*; hence it would appear probable that in 1835, when the *London* observations were made, these cylinders, with their then stronger intensities, at *Madras* would have performed 100 vibrations in something like 294*s* and 307*s* respectively: as the numbers now stand (recollecting that $\frac{h}{h'} = \left(\frac{T'}{T}\right)^2$; and putting $h = 1$ for the horizontal intensity of London)

we get from cylinder No. 3 × ; $h = 2.174$
and ——— No. 3 $h' = 2.225$—

whereas, from the somewhat probable numbers we have just assumed,

cylinder No. 3 × gives $h, = 2.268$
No. 3 — $h = 2.264$

The latter numbers, if admitted, now remain to be diminished in the proportion of 1.0098 to 1.0000 for the local influence at Madras; when, with reference to the formula at page 269, we get

	Horizontal Intensity.	Total Intensity.
in London.	1	1
Magnetic Equator Longitude 79° E.	2.259	,8065

In conclusion, I cannot but feel regret that I have devoted so much space to the discussion of observations, which in the end have furnished results of but comparatively little importance; but, viewing these observations as a part only of a series, which will probably ere long be extended to the most northern limits of India, and perhaps some parts of Persia, it becomes a question, whether, on the whole, they are not just what could be desired.

Madras Observatory,
9th March, 1839.

NATURAL HISTO

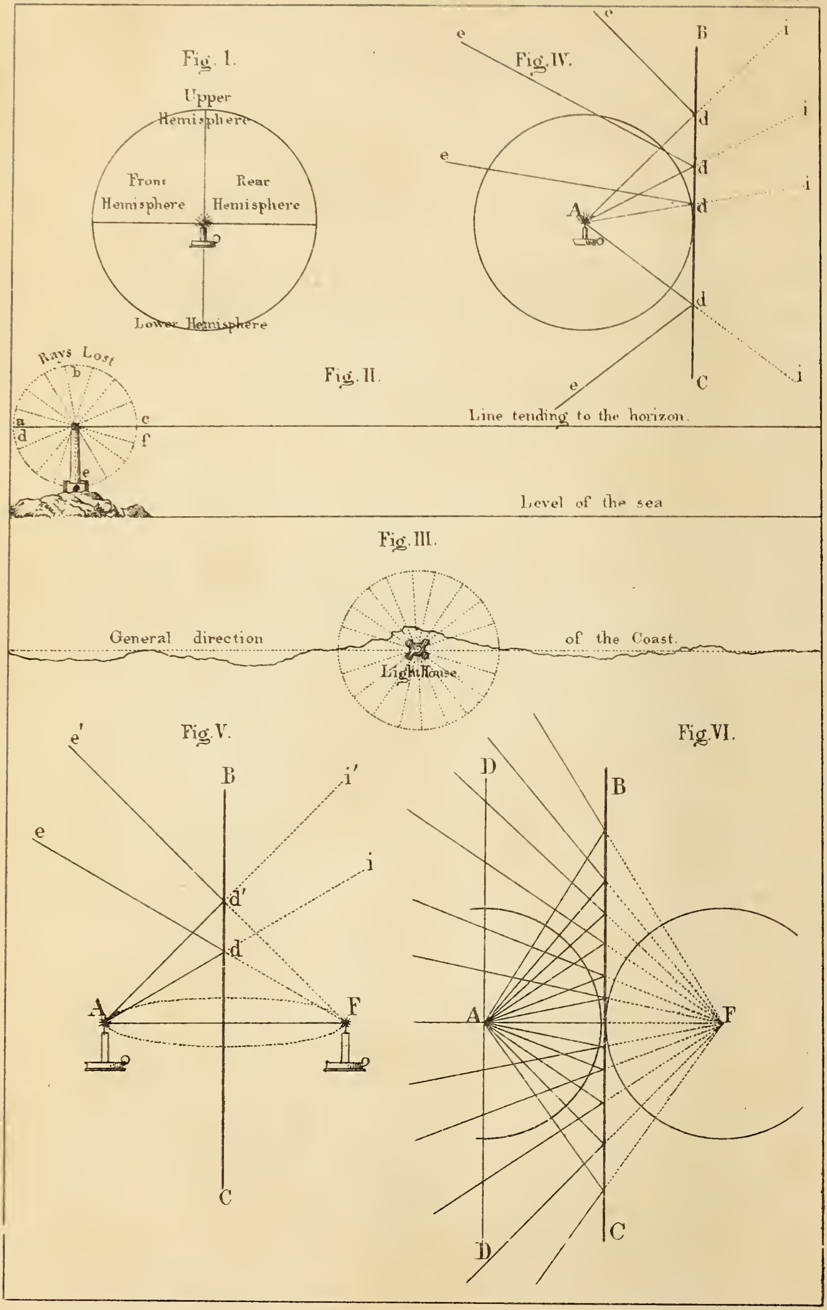


Fig. I.
Upper Hemisphere
Front Hemisphere
Rear Hemisphere
Lower Hemisphere
Fig. IV.
e
e
e
e
B
C
A
d
d
d
d
i
i
i
i
Fig. II.
Rays Lost
a
b
c
d
e
f
Line tending to the horizon.
Level of the sea
Fig. III.
General direction of the Coast.
Light House
Fig. V.
e'
e
B
C
i'
i
d'
d
A
F
Fig. VI.
D
D
B
C
A
F

III.—*An Investigation of the Nature and Optical efficiency of the combination of Mirrors used to augment the illuminating power of the Madras Light.—By Captain* J. T. Smith, *Engineers, F. R. S.*

To the Editor of the Madras Journal of Literature and Science.

Sir,

On looking through some old papers, I have met with, and have the pleasure to send you the accompanying essay, which was written in the year 1833, with a view to publication, but which from accidental causes was then laid aside. As the subject has more of a local than general interest, and as the evils which are herein pointed out are likely to be soon remedied, I should not now have ventured to request you to give it insertion in your pages, were it not possible that some benefit might result from an exhibition of the defects of a contrivance, which has hitherto been but little studied, and has been supposed by some to possess considerable merit for its simplicity; at a time when the increasing intercourse between the different parts of India, and the urgent demand for the better illumination of our coasts, renders the adoption of a correct theory, and more efficient means, every day more and more desirable.

The analysis which forms the chief object of this paper, owes its origin to an enquiry in which I was engaged at the time I have mentioned, some scattered memoranda of which were collected and arranged in the way in which they now stand; and, in order to introduce the subject to the perusal of the general reader, I have thought it necessary to premise a few general observations on the distribution of light, and the nature and objects of Light-house illumination, together with a few remarks upon the leading principles by which the latter is governed; a distinct understanding of them being almost indispensable to a clear explanation of the mode of investigation which has been adopted.

Madras, *December 8th*, 1838.

Preliminary Observations.—Every luminous point whatever throws out rays in all directions, and is equally visible at the same *distance* in every possible situation. This may be illustrated, by supposing it placed in the centre of a hollow sphere, every portion of the surface of which would receive an equal number of its rays, and be equally illuminated by it.

I shall have occasion hereafter to speak of the upper half of this sphere as the upper hemisphere of rays (Fig. 1 Pl. 3), and the lower half as

the lower hemisphere. In the same manner, of two other similar divisions of it, formed by a plane perpendicular to the former, (which is supposed to be horizontal) as the front and rear hemispheres, as regards the situation of the light in reference to a reflector or any particular object. The rays proceeding *directly* from a luminous body to the eye, and thus visible, may be termed the original or *direct* light, in contradistinction to that visible after *reflection* from any bright surface.

Under most of the circumstances in which light is usually required, as for instance, in illuminating apartments &c. the whole of the rays of direct light, corresponding to every part of the above sphere, are of equal value, those proceeding in an upward direction serving to illuminate the ceiling and upper parts of the room, and those proceeding in a direction *from* the eye, being reflected from other objects and rendering *them* visible ; the intention being in this case, to afford as much light as possible to the various objects placed in different situations round the luminous body, and not particularly to throw a large quantity towards the eye ; as it is not the *light*, but the *objects*, which it is most desirable should be seen.

In a Light-house, however, the case is just the reverse, for there are here *no* objects whatever to be illuminated, the great point to be attained being to throw as much light as possible to the observer. Now as it is evident that in respect to a luminous body placed in a Light-house the eye can never be situated in any part of the *upper* half of the sphere of rays above alluded to, since the line connecting the light and the horizon would be barely even horizontal, it follows that the whole of those rays must be entirely lost. If the Light-house from being insulated be required to illuminate the circumference of the horizon all round, nearly all the remaining, or lower half of the sphere of rays, will be effective, as those which fall below the horizon line will be visible from points nearer to the light, and consequently forming an angle of depression with it ; and the only rays of the lower hemisphere lost will be those intercepted by the brick work of the building itself. This will I hope be clearly understood by a reference to Fig. 2 which represents a vertical section of a Light-house situated as above supposed, and in which the unserviceable rays, or those lost in consequence of their emanating in directions *above* the level of the horizon, are comprised within the semicircle *a b c* (which is the *section* of the upper hemisphere before spoken of) while the serviceable rays, or those which are visible from points at different distances from the building, are included within the lower semicircle *d e f*.

In many instances, however, illumination may be required to extend

to only half of the whole circumference of the horizon, which is frequently the case when the situation of the Light-house is on the edge of a straight line of coast, (as at Madras) and it is required merely to be visible from the sea. Under these circumstances, it is evident, that only a half of the before mentioned hemisphere of *serviceable* rays are available for the purpose required, since all that emanate towards the opposite hemisphere fall in rear of the line of coast, and are consequently entirely useless, as exhibited in figure (No. 3). In other words, in such a situation, out of the whole sphere of rays proceeding from the luminous object, one half is lost owing to their being projected in directions *above* the horizon, and one half *of the remaining half* by falling in rear of the line of coast.

In other cases, when the situation is such as to require a greater or less portion of the circumference of the horizon to be illuminated, as for instance, if the Light-house be placed upon a promontory, or within a channel or harbour, the ratio of the serviceable rays to the whole illuminating power of the lower hemisphere will be in proportion to the extent of that part of the circumference whence they are required to be seen, to the whole periphery of the circle. When this ratio is one half, or 180° the proportion of the rays from which benefit is derived is as before stated, one half of the inferior hemisphere, shown in Fig. 2, or ¼ of the whole of the rays proceeding from the luminous body, no advantage whatever being derived from the remaining three-fourths.

The great loss of light here shown to occur in situations similar to that of the Madras Light-house, has led amongst other contrivances, to the invention of metallic and glass mirrors for the purpose of reflecting as many as possible of these truant rays, by diverting them from their natural directions into others in which they would be visible.

These mirrors may be either plane or curved.

It is my intention in this paper merely to consider the properties of plane mirrors, with a view of estimating the assistance they afford when arranged in the manner in which they are at present applied in the Madras Light-house, my object in selecting that work being principally to put an end to all doubts as to the possibility of great improvement in it, and at the same time, if possible, to lead the way to the rejection and removal of a clumsy contrivance, by demonstrating the extreme inefficiency of the arrangement, and tracing it to its proper causes.

Previous, however, to entering upon this investigation, it is necessary to prepare the way for it by a brief attention to a few of the fundamental laws of optics upon which it is founded, and which I hope I shall be ex-

cused for taking notice of in this place, as although devoid of novelty and interest to the scientific reader, they are nevertheless indispensable to a proper understanding of what follows, by those who may have devoted less of their time and attention to the subject.

When the rays of light proceeding from a luminous point are reflected from a plane, they proceed *after* reflection in lines which will slope as much *from* the plane as they before sloped *towards* it.—Namely, if A *d*, A *d′* (FIG. 5) be any rays of light proceeding from a point A and striking a plane B C, they will *after* reflection slope *from* the plane at angles B *d e*, B *d′ e′*—equal to the angles A *d* C, A *d′* C at which they before sloped *towards* it. Hence it may be easily deduced that the obliquity of the rays *d e*, *d′ e′*—from the *front* of the plane is exactly the same as that of the lines *d i*, *d′ i′*, in which they would have proceeded to the *rear* of it if not intercepted. The effect of the reflection being exactly the same as of the light at A were turned half round an imaginary axis B C to a new position at F, so that the rays proceeded to the front instead of the rear of plane as shown in the figure.

It must also be remarked, that the divergence of the rays with respect to one another remains unaltered, the angle *e f e′* being in every case unchanged, and continuing equal to the angle *i a i′*, the effect being merely to *reverse* the whole of the rays composing the hemisphere of light next the plane, without in the least interfering with their relative inclinations.

If we now suppose a plane polished surface to be placed immediately in rear of the imaginary sphere of light before spoken of, it will be easy to understand from what has just been explained, that its effect would be to turn the whole* of the rays comprised in the rear hemisphere, and cause them to proceed in directions exactly similar to those pursued by the rays emanating from the front one. In applying this to the aid of Light-house illumination, therefore, such a contrivance, would, in cases when only half of the circumference of the horizon is required to b illuminated, *double* the useful light, by in fact converting one complete sphere of luminous rays into *two front*, instead of one front, and one rear hemisphere.

What has been hitherto said has referred only to a single luminous *point* infinitely small, but as the same is equally true regarding every point constituting a body of light of any size, it follows that in every situation from which it has been shown that the rays from a single point

* This of course supposes the plane to be unlimited in extent, as the rays nearest the diameter AD would not meet it, except at an infinite distance. In practice, therefore, the *whole* of the rays cannot be returned by a plane mirror, for the same is true also when taken in a *lateral* direction, and the number lost will depend upon the size of the plane and its distance from the radiant point.

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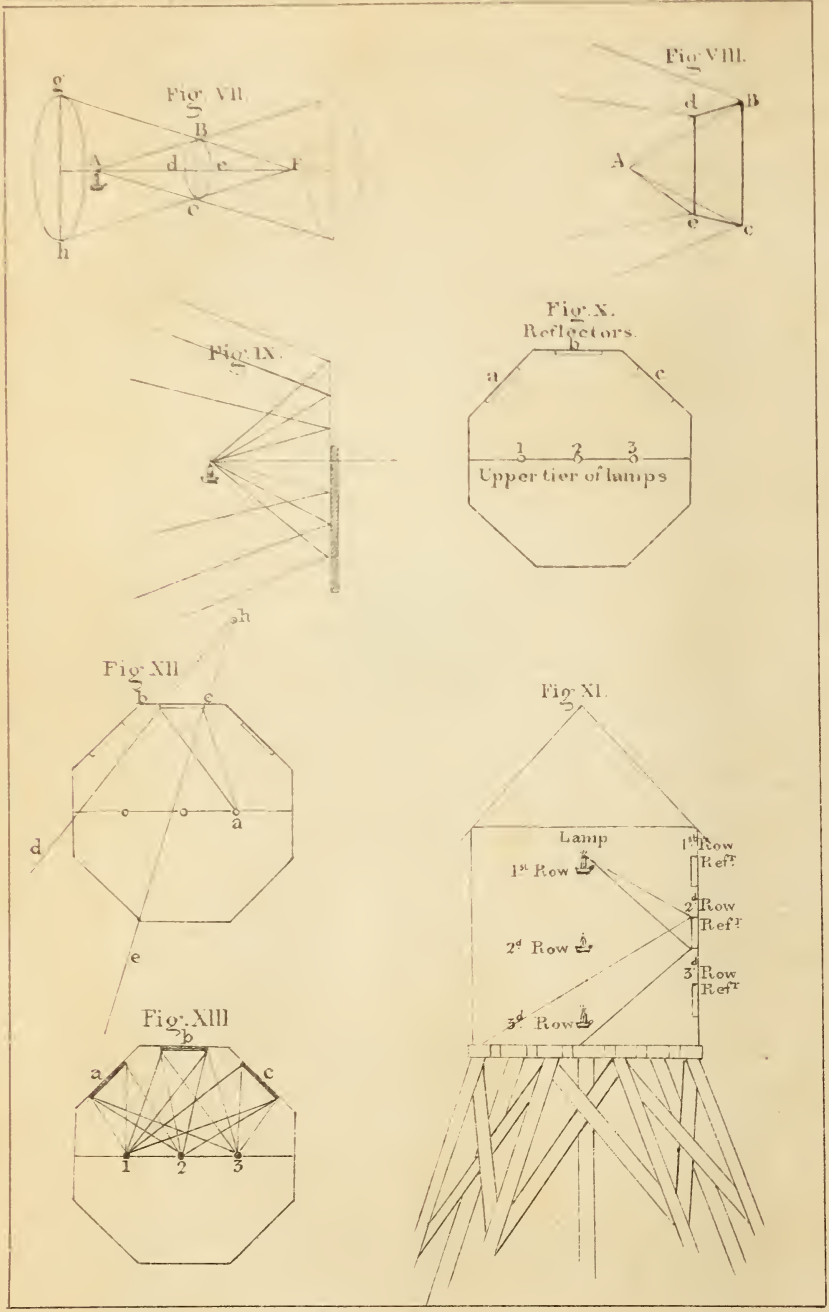


Fig. VII.
g
B
A
d
e
F
c
h
Fig. VIII.
d
B
A
e
c
Fig. IX.
h
Fig. X.
Reflectors.
b
a
c
1
2
3
Upper tier of lamps
Fig. XII
b
c
a
d
e
Fig. XI.
Lamp
1st Row
1st Row Refr.
2d Row
2d Row Refr.
2d Row
3d Row
3d Row Refr.
3d Row
Fig. XIII
b
a
c
1
2
3

would be visible, in the same situations the rays from the other points would also be seen, constituting *images* of the flame or luminous body, of whatever kind.

In this manner an image of a candle will be seen by reflection from a circular looking glass or mirror, in all those situations embraced by a cone of rays proceeding from it in the directions pointed out by the above law—namely, if A (Fig. 7 Pl. 4) be the light, and B C a circular plane mirror, a reflected image of A will be visible from any point within the frustum of the cone B C *g h*, formed by the reflection of the rays impinging on the circular area B *d* C *e*.

If the mirror be *square* then a reflected image of the light will be visible in any part of the *pyramid* of rays, formed in the same way, as shown in Fig. 8.

From what has been said in the former part of this paper, taken in connection with these circumstances, it will be easily seen, that in order to produce the utmost beneficial effect, no part of a plane mirror, if placed vertically, ought to be above the uppermost part of the light to which it is adapted, as in that case, the rays which would be reflected from that part of it, would be those belonging to the *upper* hemisphere, which I have already shown to be useless (vide Fig. 9). I am not aware whether this circumstance has been attended to in the disposition of the reflectors in the Madras Light-house, having never examined the apparatus, but I shall suppose such to be the case, and that they are disposed to the greatest advantage they are capable of, as even were it not so, it is a defect which could be very easily remedied, and it is my object to show, not that a bad use has been made of efficient means, but that the contrivance itself, under the best arrangement, is of much less value and assistance than has generally been supposed.

I shall now proceed to a description of the lantern of this Light-house, and to dissect the operation of, and calculate the value, of the assistance rendered by the reflectors contained in it. In doing this, I shall as I before stated, suppose every mirror to be placed in the most advantageous position (with regard to height), viz., so that the image reflected from the *upper* portion of it is visible on the edge of the horizon, and that the lower portions in turn, successively, afford light to the points nearer to the building itself.

The shape of the lantern is an octagon, three sides of which, towards the land, are opaque, and the remaining five sides glazed. On the three first opaque sides are placed the reflectors, in three rows, one above the other; they are squares of one foot each side, of looking-glass, and occupy the centre of each of the sides of the polygon as shown in the plan Fig. 13.

The lamps, which are 12 in number, are also arranged in three tiers, corresponding to those in which the mirrors are placed, but the number in each row is not the same, that of the top row being 3, in the second 4, and in the third 5.

From the accompanying section (Fig. 11) it is evident, that no assistance whatever is derived by any lamp, from any of the mirrors except those in the *same tier* with itself, an inspection of the figure showing at once, that the image reflected from a mirror situated in the row *beneath* the lamp, would be merely visible at the very foot of the Light-house, even if it did not fall within the limits of the building itself; and I have before said enough to explain, that no benefit whatever would be derived by any aid from a mirror in the tier *above* it, all the rays of which would strike the roof of the lantern, or be lost in the air. It is unnecessary therefore to pay any attention to the operation of the reflectors, with reference to any of the lamps except those belonging to the same tier, and I shall therefore proceed to enquire into the aid afforded by those in each row to every lamp belonging to it, in turn; and admitting the very favourable assumption before alluded to, that the images when visible at any point on the horizon, will also be visible at every point in a direct line between it and the Light-house, shall now measure the extent of the circumference in a *lateral* direction through which this effect will take place.

In order to calculate this, it is merely necessary to consider, that the reflected image of any one of the lamps, will, as before explained, be visible in each mirror merely within the limits embraced by the pyramid of rays reflected from its surface, and also, that any attention to the *vertical* divergence, or angle formed between the *upper* and *lower* sides of this pyramid, is rendered entirely unnecessary, by assuming that it produces the greatest possible effect it is capable of, in rendering the image visible to the very foot of the Light-house. It will therefore only remain to ascertain the *lateral* extent of these rays from each mirror, to obtain the number of the degrees of the horizon illuminated by the *reflected* light of the lamp from which they proceed, and within which its image will be visible; and by repeating this with each lamp and each mirror, ascertain the effect produced by the whole combined. Now, it has been before observed, that the divergence of the rays before and after reflection remains the same, and that the sides of a cone or pyramid of reflected light, have exactly the same mutual inclination, and comprehend the same angle after quitting the plane, which they subtended before reaching it. For instance, that if a be the lamp, (Fig. 12) and $a\,b$, $a\,c$ the limits of a pyramid of rays striking the surface of the

mirror *b c* and reflected from it in the directions *b d*, *c e*, that the angle *d h e* comprehended between the sides of the *reflected* pyramid *a b c e*, will be equal to the angle *b a c*.

In order, therefore, to ascertain the lateral extent embraced by each pyramid of reflected rays, it would answer the purpose just as well, if instead of projecting and taking the measurements of these rays themselves, we were to substitute for them the angles which each lamp forms with the two edges of each mirror, viz. if the angle *b a c*, shown in the annexed plan, be substituted for its equal *d h e*. As this is a much less troublesome operation, and as it renders the figure less complicated, I have accordingly done so ; and the following are the measurements of these angles, for the three rows, taken separately, as shown in the accompanying plan, Fig. 13.

Table, showing the breadth of the angular spaces illuminated by the reflection of the light of each lamp from the different mirrors.

No. I Tier.

Of three lamps and 3 reflectors.

Lamp.	Reflector.	Angle.	Total.	
1	*a*	22		
„		14½		
„	*c*	12½	49	
2	*a*	19		
„	*b*	19		
„	*c*	19	57	
3	*a*	12½		
„	*b*	14½		
„	*c*	22	49	155°

In each table the *numbers* refer to the different *lamps* belonging to the tier, which are numbered from left to right as shown in the plan. The letters *a*, *b*, *c*, refer to the three reflectors, which are taken in the same order. "No. 1, *a*" consequently, refers to the rays proceeding from the *left hand* lamp, and reflected from the mirror nearest it on the same side.

From the above measurements it appears, that a reflected image of the centre lamp will be visible throughout 57 degrees of the circumference of the horizon, and of the other two in 49 degrees each.

Therefore, if the effects be *equally* distributed over the whole illuminated space, there would be visible from the *upper* row of lamps and

Fig. XIV.

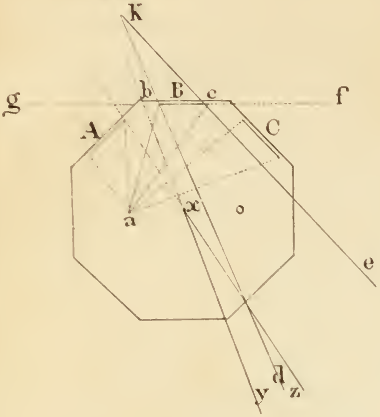


Fig. XV.

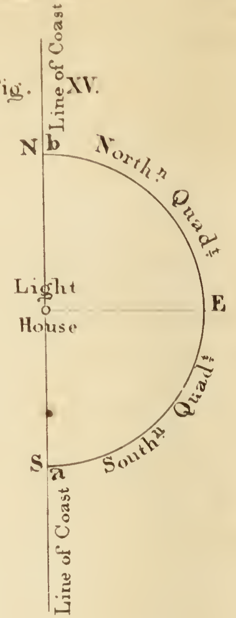
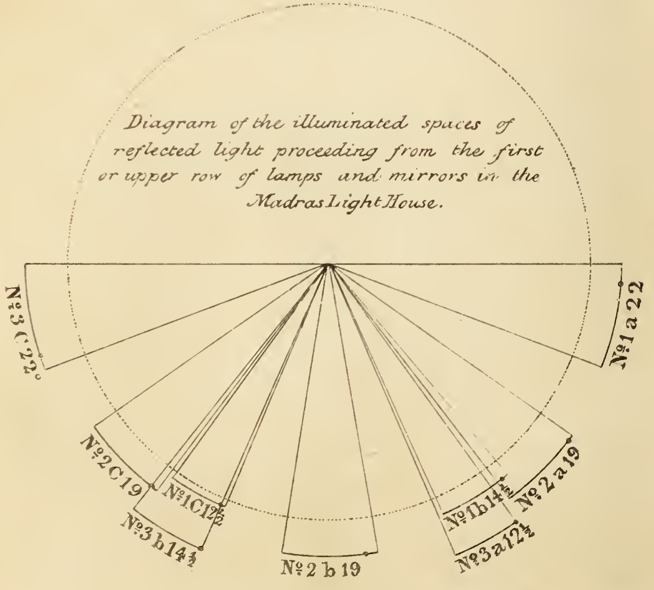


Fig. XVI.



material composing the mirror was speculum metal of highly brilliant lustre, and polished in the most exquisite manner, it would not be assigning too little to mirrors of looking-glass of the common description, to assume that they would only return 50 out of 100.000, or one half of the incident rays. In this case, what would be the value of the nine reflectors? In the most favourable situation it would appear that they would increase the brilliance of the 12 lamps so as to render them equal to *fourteen*, and in less favourable ones, that their assistance is not much superior to the addition of a *single* extra lamp.

I am aware, however, that this estimate has been made to rest upon an assumption, which may not, upon examination, be found to correspond with the actual circumstances of the case. It is indeed highly probable from the nature of the apparatus, that the duly regulated distribution, necessary to produce an exact equality of light may not be attainable, and that great irregularity in this respect may be found to exist. Admitting such however to be the case, the above would still be a correct measure of the *average* effect produced throughout the whole extent of the horizon, and a fair statement of the benefit derived from the apparatus, as it is evident, that if, owing to such inequality, it should be found that the effect produced in any particular point of the circumference were much in excess of what is above assigned, such a circumstance could only be occasioned, by a corresponding defect in some other quarter, which would fall short in an equal degree.

In order, however, to prevent this point remaining a subject of doubt, I have thought it worth while to lay down on paper, in the accompanying plans (Figs. 16, 17 and 18), the whole of the diverging rays, in the situations in which they are actually reflected, making the angles of incidence and reflection equal, in accordance with the law in optics before alluded to, so as to exhibit in one view the whole of the spaces in which the reflected images of every lamp, from the surface of each reflector are to be found.* The manner in which this has been done is represented in Fig. 14, where the positions of the rays *c e* and *b d*, have been ascertained

* It will be observed that in the 17th and 18th figures one angular space on each side is made to overlap, and in part to fall in rear of the line *g f* of Fig. 14, parallel to the surface of the central mirror, and it is evident that not only these, but also a small portion of the rays in front of them, towards A and C could not be visible, owing to their being intercepted by the opaque sides A and C. I have thought it better however to leave them in Figures 17, 18, and 19, in the places to which they would be *directed* by reflection, in order that each group of rays might be duly accounted for, but they have afterwards been deducted in summing up the effects and arranging them in a tabular form.

by marking off the angles $f\ b\ d$ and $f\ c\ e$ equal to their corresponding angles of incidence $a\ b\ g$ and $a\ c\ g$.

The same having been done regarding the other two reflectors A and C, a similar operation was performed,and a similar set of angles obtained from the second or middle lamp, and afterwards from the third, until the whole set belonging to the first tier of lamps and reflectors was complete.

As the figure would have been very much confused from the intersection of so many diverging lines from different points, owing to the difficulty of referring them to their respective centres, and comparing their relative directions, I have in the diagrams representing the spaces illuminated by the three different tiers (Figures 16, 17, and 18), referred the whole to a common centre, an arrangement which greatly facilitates their comparison with one another, as it exhibits them combined under one view, at the same time that it does not in the least affect the truth of the representation, as the distances of the real points of divergence from the central point of the light room to which they are referred, is so small when compared with the distance of the circumference of the horizon on which the angular spaces are measured, that the effect produced by the change in position which such an arrangement requires, is in reality entirely imperceptible.

In order to render the operation here alluded to, still more easily understood, I have represented the manner of effecting it in the figure last given. The point to which all the cones of rays are referred is there represented by x – $b\ d$ and $c\ e$, are the resulting lines of direction of the two rays $a\ b$, $a\ c$ proceeding from the lamp a and reflected from the mirror B. The angle which they subtend with one another, and the general direction of the cone of rays, is at once obtained by producing them till they meet in K, and the angle which is substituted for it at the point x is found by drawing $x\ y$ and $x\ z$ parallel to $k\ d$ and $k\ e$. In the three figures Nos. 16, 17 and 18, these angles have been laid down separately for each row of reflectors and lamps, as it has before been shown, that no reflected light is visible, from the lamps of one row and mirrors of another. In order to distinguish the different sectors of rays from one another, they have all been marked, both with the number of the lamp whence the light originates, and the particular reflector from which it is thrown, in the same manner as in the tables before given. For greater convenience in summing up the results also, the number of degrees comprehended by each group of rays is also marked upon the plan, and in Fig. 19, the whole of the preceding results are brought together at once, by combining the three Figures 16, 17 and 18, into one. In considering the

Fig. XVII.

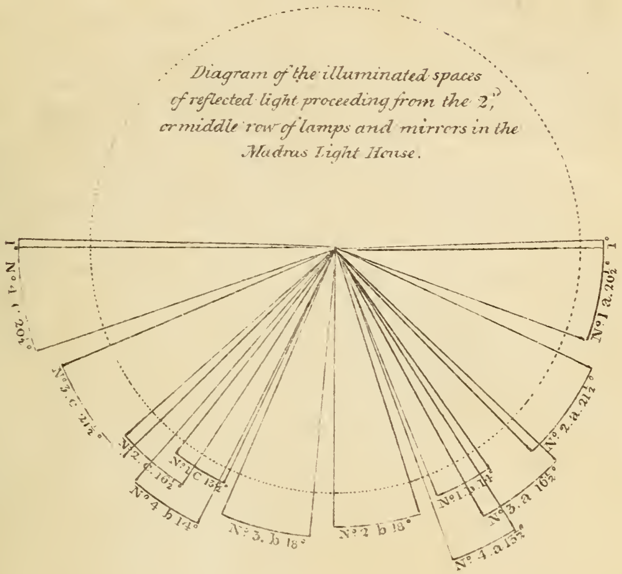
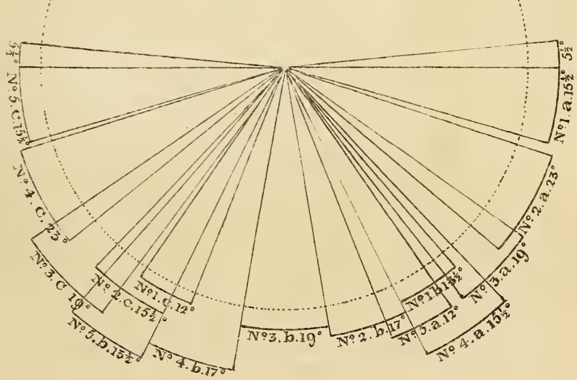


Fig. XVIII.



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result thus obtained, it should be carefully borne in mind, that each of the sectors laid down in the three figures, represents the angular portion of the horizon throughout which the reflected image of some *one* of the lamps is rendered visible, by means of *one* of the reflectors, and consequently, that when two or more of these angular spaces occupy the same part of the horizon, or overlap one another, two or more images will be seen, and so on.

The object of the arrangement adopted in the 19th figure, is, by exhibiting the whole of the reflected rays in one view, to point out, both where irregularity in the distribution of the light exists, and also the exact quantum of advantage derived from the reflectors in every separate portion of the horizon, as the number of reflected images visible in any particular point of it will of course be shown by the number of angular spaces of rays, within whose confines it may happen to be situated. With regard to the first point it will at once be seen from the figure, that very great inequality in the diffusion of the light prevails, the whole of the diverging beams appearing to be huddled together near two points equidistant from the centre of the semi-circumference*, while that part itself, and the portions near the diameter *a b* (in Fig. 15) are in comparison very scantily supplied.

As there is some difficulty, owing to the number of lines indispensable to the figure, in distinguishing the angular spaces from one another, and ascertaining the number which lie over any particular part, I have in Fig. 20 given another representation of the same semi-circumference, in which the differently illuminated parts are marked off, and distinguished from one another according to the number of reflected images visible within them, and, as the number of degrees of each of these spaces is marked on it, as well as the number of images visible throughout it; this figure contains within itself, a condensed view of the whole of the results exhibited in the other four diagrams.

I have also given a tabular form to the contents of the last diagram No. 20, in order to admit of a mean being found, and a comparison made, with the estimate of the *average* effect formerly taken. This has been obtained by multiplying the number of images visible in any part of the horizon, by the breadth of the space, expressed in degrees, throughout which that number is seen, and adding the whole of the products together, and dividing by the number of degrees contained in the entire semicircle; by this process, and after rejecting the first $5\frac{1}{2}$ degrees in each quadrant represented in Fig. 19, in consequence of their falling

* Measuring about 30° on each side, from the point E (of Fig. 15).

outside of the semi-circle, the sum of all the products is found to be 601½, which divided by 180° gives 3.34 as representative of the *mean* value expressing the number of reflected images throughout the whole circumference, a result which corresponds, pretty nearly, with that formerly obtained which represented *less* than four and *more* than three images, and in nearly the same proportion, viz.

$$3 \text{ and } \frac{84}{180\text{ths}} \text{ or } 3\ \frac{21}{45\text{ths}} = 3.4 -$$

In the following table the different spaces have been marked down in the order in which they occur, on tracing the circumference from South to North, or from *a* to *b* in the annexed diagram No. 15.

TABLE

Of the breadths of the various portions of the horizon differently illuminated by the reflected light, with the number of images visible in each.

	Southern Quadrant. Breadth of the spaces illuminated.	Southern Quadrant. Number of images seen in them.	Northern Quadrant. Breadth of the spaces illuminated.	Northern Quadrant. Number of images seen in them.	
a	Degrees.. 16	3	Degrees... 2¼	2	E
	1½	2	7¼	3	
	3½	3	10¾	2	
	1	2	1¼	1	
	3½	1	0¼	3	
	10½	2	0¾	4	
	4	4	3½	6	
	4	3	3	7	
	3	4	4	8	
	1¼ ...	3	1	7	
	2¼	4	0½	6	
	2¾	5	0½	5	
	1¾ ...	4	1¾	4	
	0½	5	2¾	5	
	0½	6	2¼	4	
	1	7	1¼	3	
	4	8	3	4	
	3	7	4	3	
	3½	6	4	4	
	0¾	4	10½	2	
	0¼	3	3½	1	
	1¼	1	1	2	
	10¾	2	3½	3	
	7¼	3	1½	2	
E	2¼ ...	2	16	3	b

Fig. XIX.

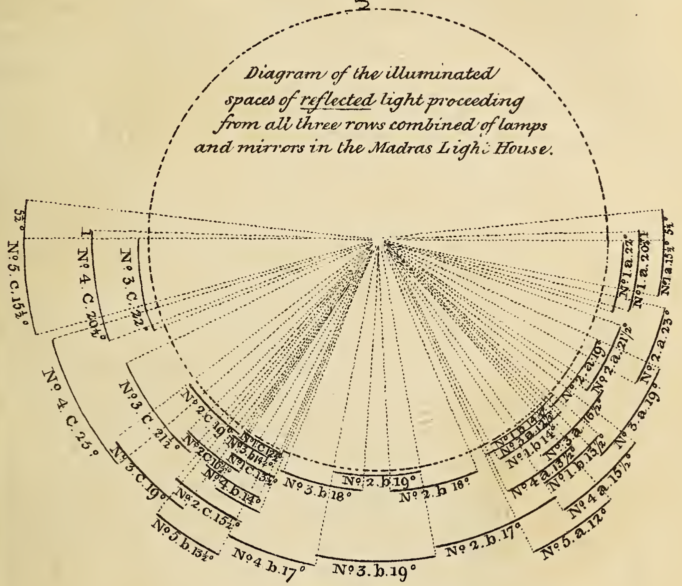
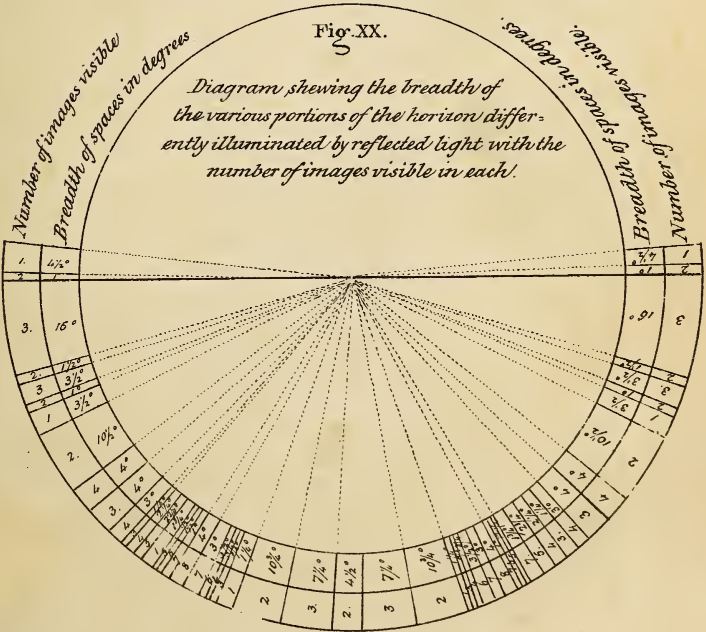


Fig. XX.



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By arranging the contents of this same table in another form, by adding together the spaces in which the effects produced an equal, it will appear that there are

9½	degrees in which only one image is visible	1
52	...... in which	2
64½	...... ,, ...	3
23½	....	4
6½	...... ,, ...	5
8	...... ,, ...	6
8	...... ,, ...	7
8	...... ,, ...	8.

Or to condense it still more, that out of the whole semi-circumference of 180 degrees, the portion in which 1.2.3 and 4 images of a *single* light only are visible, amounts to 140°, or 7-9ths; the remaining 2-9ths being illuminated by 5.6.7 and 8. When it is recollected that, as before shown, the brightness of these images is only one *half* as vivid as that of the *direct* unassisted light, and when it is also considered, that the total value of this *direct* light is represented by 12 of these doubly powerful images, visible throughout the *whole* circumference of the horizon, it will no longer be a matter of surprise that the light in its present condition, although stated in the Almanac to be visible (by which I understand *possible* to be seen) at a distance of 27 miles from the mast-head of a large ship, is in matter of fact with difficulty discerned at 15 or even 10.

It might have been expected, that the very great difference above shown to exist in the value of the assistance afforded by the reflecting apparatus, as seen from different points, would have occasioned a material inequality in the brightness of the beam generally, as viewed from a distance in different directions; which, had it prevailed to any extent, could not fail to have attracted attention; and there is no doubt that such would have obtained, if the whole effect produced by reflection, bore any thing like a large proportion to the whole illuminating power. But it has been before shown, that in the situations where it is most powerful, and even within the very small limits in which 8 reflected images are seen, the actual increase of the refulgent power exclusively due to reflection has no more effect than would be derived from the addition of 4 extra lamps; or that the share of effect due to the assistance of the reflectors, is even then, only *one-fourth* of the whole brightness of the visible beam. It is therefore hardly to be expected, that a gradual increase or diminution of power which at its maximum does not exceed 1-4th, and whose *average*

barely exceeds 1-8th, should be capable of producing any very sensible alteration: which, even if it did take place, to a much greater extent than is here shown to be possible, would be entirely lost in the fitful and uncertain glimmering, which characterises the whole beam at great distances.

It has been my object, however, in what I have above written to demonstrate, not so much that the light must of necessity be defective, as that if it should happen to be so, abundant reasons might be shown to exist for anticipating such a circumstance, from causes which it has been my endeavour to point out. I leave the fact of its *being* so or not, to be established by the testimony of those who may be able to speak from experience, and will at present merely add, that if the opinion which I at the commencement of this paper ventured to express, regarding the extreme inefficiency of the contrivance as it exists at present, be granted to be correct, it would not be unreasonable to anticipate, that a considerable improvement in it might be effected, if the importance of the light were considred sufficiently great, to warrant the expence of its being remodelled upon a more scientific plan, and which I feel satisfied might be done without any very alarming outlay. It was my intention to have appended to this some observations on the spherical and parabolic mirrors used in England for this purpose, in the hopes of attracting to the subject the attention of others more competent to examine it than myself; but I have already been carried to a length so far beyond what I originally intended, and the subject is one of so little interest to the general reader, that I cannot expect to be granted the indulgence of further occupying the pages of your valuable work, to the exclusion of more important matter, and I must therefore content myself with the hope, that should communications of this kind be suited to the character and objects of the "*Madras Journal of Literature and Science,*" I may at some future period, have it in my power to make up for the deficiency.

I remain, &c.

J. T. S.

Madras, November 1833.

IV.—*On the Crystalline Structure of the Trap Dykes in the Sienite of Amboor: with an Enquiry into the Causes to which this Peculiarity of certain Igneous Rocks is due.—By* RICHARD BAIRD SMITH, *Lieutenant, Madras Engineers.*

The phenomena exhibited by the internal structure of certain rocks, which a large class of facts clearly prove to have been, more or less, acted on by subterranean heat, have lately had the attention of observers specially directed to them; and a wish has been expressed by an eminent geologist,* that, since the study of these peculiarities has, as yet, received but little attention, it would be therefore desirable, that information should be collected relative to them, for the purpose of enabling us to enquire into the causes of their production. Having lately been enabled to examine the geology of the route from Madras to Bangalore, I was especially interested in the results of an examination of the trap dykes, in the sienite around the village of Amboor; and since in these the phenomena, above alluded to, were strikingly exhibited, I have ventured to throw together a few remarks deduced from these observations. Since the field is one of comparative novelty, perhaps interest may be excited, and the attention of those qualified to explore it, be directed more particularly towards collecting the information relative to it, so much desired.

The underlaying rock of the plain on which the village of Amboor is situated, is the sienite so universally met with throughout the range of the ghauts. This sienite outcrops at various points in the plain, and occasionally by its disintegration, gives rise to boulder-like masses, which are found scattered around in great abundance. Mingled with these, are weathered, and apparently water-worn, fragments of other rocks, as of granite, gneiss, &c. varieties of trap, compact, and vesicular felspar, quartz, and porphyries. The non-appearance of the parent rocks, from which these fragments have been derived, in the neighbourhood, or actually *in situ*, proves that some transporting agent has been acting upon them. This perhaps may have been the nullah which intersects the plain, and seems to take its rise among the distant hills, where, doubtless, the rocks above mentioned are largely to be met with, since all belong to the primary series. These may have formed the bed of the stream, and, thus being subject to continued abrasion, they would readily yield to any increased force the current might acquire, from the

* Mr. De la Beche—"How to Observe."

fall of rain, or other similar causes, masses would be detached, and borne along to distances according to their size and weight. They seemed all nearly of the same size, and of equal specific gravity, hence we may infer, a transporting power of equal intensity had acted on all, and hence, also, an additional argument might be derived for their being true boulders. On finding, however, that in one part of its course, the nullah was confined by an artificial bund, mainly composed of masses similar to those strewed over the plain, the possibility, that the latter might have been derived from the former, suggested itself, and naturally tended to throw doubts on the first idea, that the masses had been brought, by the force of the stream, from the distant hills; evidence is however, wanting to enable the inquirer to form any decided opinion, and, therefore, it is best to rest satisfied with a simple statement of facts, without attempting to draw conclusions, for which these cannot be deemed sufficient warrant.

The road to Palliconda intersects the range of hills which forms the enclosure to the plain of Amboor, at a distance of about half a mile from the latter place. At this point, the road winds along between two hills forming portions of the main range. To the left hand of one of these, my attention was particularly directed*, and on examina-

* At Palliconda, I examined with much interest the geological features of a large hill in its vicinity which I subsequently found had been described by Dr. Benza. On comparing my notes with his description I found there was no essential difference between them, save in one or two trifling instances, arising from the different degrees of attention with which we had examined different localities. I will annex therefore in this note only a rapid sketch of the results of my observations, referring those desirous of seeing the subject treated in greater detail to the paper above alluded to. The plain at the base of the hill is sandy, and strewed over it, there are masses of a sienite, which, as is proved by the natural sections exposed at various points in the beds of the neighbouring nullahs, forms the underlaying rock of the whole. Traversing this there are dykes of trap and porphyry, with veins of quartz and felspar. The two latter are sometimes found together—the quartz massive and the felspar crystalline, forming together a compound coming under the class porphyry. Since it is a general principle, recognised in naming different members of this class, to distinguish these by affixing the name of the matrix in which the crystals are imbedded to that of the general class, I have adopted the name of quartz porphyry for the above. It may be remarked in passing that it is of the greater importance to adhere to some general principles in the nomenclature of geology, as few sciences have suffered more from these having been lost sight of. The progress of our studies is most seriously impeded by the different arbitrary systems authors have employed, and the necessity for a table of synonyms is absolute when we wish to compare different works, each of which perhaps describes the same rock under names so different as to render their identification quite impossible. Investigating a portion of this quartz porphyry, I found a simple mineral to which I could not assign a name, never having seen it before. The characteristics of this are as follow—lustre highly metallic, inclining to adamantine—colour dark grey, nearly black—hardness between 7 and 8—fracture splintery—structure laminated—specific gravity not numerically determined, but high—crystalline

tion, I found it to be wholly composed of sienite, intersected by various trap dykes of different dimensions. These dykes maintained, throughout their whole extent, one uniform and parallel direction, being all at right angles to the line of the road intersecting the main range, and consequently parallel to the main range itself.

The trap, of which these dykes are composed, consists of a matrix of dark coloured granular hornblende, throughout which small grains of mica are interspersed.

On examining the trap at its lines of junction with the including sienite, decided marks of alteration are observable in the former, though not in the latter—the hornblende becoming of a much lighter colour, while the grains of mica become larger, and most distinctly developed. Traversing the dykes, and *invariably* at right angles to the cooling surfaces of the sienite, I found small cracks or fissures—a similar remark to this, has been made on the comparatively recent ejections from certain volcanoes, and more especially on those of mount Vesuvius, of which Mr. Lyell remarks—" There is a tendency in all Vesuvian dykes to divide into horizontal prisms, a phenomenon, in accordance with the

form—a flat rhomboidal prism, having an obtuse angle=about 130° and an acute angle=about 50°; the want of a goniometer put it out of my power to do more than approximate to the side of the angles of the rhomboid-cleavage, regular and single in a plane at right angles to the axis of the crystal. Exposed to the action of undiluted muriatic acid it deepened the colour of this to a dark and beautiful orange hue—to nitric acid it communicated a greenish tinge, while in sulphuric acid no action whatever took place. From the two first effects I was led to suspect the mineral to be one of the crystallized salts of iron, and under this impression I added to each of the acid solutions, ammonia and oxalic acid, expecting precipitation to follow. In this however I was disappointed ; no such effect being produced. The mineral strikingly resembles in external appearance the specular iron ore, but in comparison I found they differed in crystalline form, the latter being octahedral while the former as was before stated is rhomboidal.

On examining the main body of the hill I found it composed of sienite, intersected by numerous trap and porphyritic dykes—one of the latter I found capping the sienite, so as to seem at first sight to be an overlaying rock, but on further examination its true nature is easily detected and its limits observed. Much variety is observable in the composition of the dykes and veins. Sometimes the quartz of the porphyries disappears altogether, when we have pure felspar left. Sometimes hornblende predominates, and sometimes nothing but quartz is seen. The felspar was often of a pinkish hue, and generally so much decomposed on the surface as when pressed in the hand to crumble into dust—sometimes it became dendritic, the tree-like forms being due to small vesicular cavities, presenting a very beautiful appearance. In the vicinities of the nullahs abundance of water-worn masses of basalt, greenstone, claystone, &c. are met with, though as might be anticipated they are more sparingly distributed at a distance from these. For further particulars, see Dr. Benza's paper on the Geology of the route from Madras to the Hills, in No. XII of this Journal.

formation of vertical prisms in horizontal beds of lava, for in both cases, the divisions which give rise to the prismatic structure are at right angles to the cooling surfaces." Now in the trap of Amboor, I was especially interested by finding, that, independent of these fissures at right angles to the cooling surfaces, there were also distinct planes of cleavage, or as miners call them "joints," which when combined with the fissures, render the trap divisible into these very prismatic forms, spoken of by Mr. Lyell. I found it impossible to break the trap otherwise than into regular, and prismatic fragments; and this regularity of internal structure clearly proves, that crystallizing forces must have been in operation throughout the whole, to produce such striking results. The cleavage planes invariably exhibited an ochreous hue, as if a portion of the oxide of iron, which, in a greater or less proportion, ever forms a constituent of hornblende, had been decomposed, and determined towards these planes, by an action analogous to that, by which certain bodies are determined towards the different poles of a galvanic battery.

Additional interest is attached to the phenomena above described, when we learn they are members of a class which has been largely recognised throughout the natural world. The following remarks by Professor Sedgwick, will prove their existence throughout large districts of England and Wales. In both of these countries, the slate formation is of great extent, and speaking of certain parts of it, he had examined with much care, Professor Sedgwick remarks—"Besides the planes of cleavage, formerly spoken of, we often find in large slate quarries, one or more sets of cross joints, which, when combined with cleavage, divide the rock into rhomboidal solids. These solids are not capable of indefinite subdivision into similar solids, except in one direction, namely that of true cleavage, and in this way, we may, even in hand specimens, distinguish the true cleavage planes, from the joints." This, I found, was a matter of great ease in the trap of Amboor, for, independantly of the ochreous hue before mentioned, as characteristic of the cleavage planes, the joints or fissures being free from this, it was vain to attempt to fracture a mass, save in the direction of the sides of the prisms, while when the effort was made in this manner, division was easily accomplished. Speaking of the joints, Professor Sedgwick continues—"These last are fissures, placed at definite distances from each other, the masses of rock between them having, generally speaking, no tendency to cleave in a direction parallel to them." This remark is also applicable to the trap of Amboor, the direction of cleavage never being parallel, but invariably perpendicular, to that of the fissures. These last may be attributed to the mechanical action, produced on the rock, either during con-

traction, while the fused mass originally ejected from the interior of the earth in a fluid, or semifluid, was passing into a solid state, the tension thus caused, producing more or less regular sets of cracks, or fissures. It is impossible, however, to attribute to a like origin the phenomena of cleavage planes, they being distinctive of crystalline forces, and affording proofs, that the ultimate particles of the rock have been subjected to chemical action, whereby this peculiar arrangement has been effected.

In instituting the following enquiry into the causes to which these phenomena are due, the first step will be to collect as many analogous ones as possible, and thus to form a series of classes, whose relations to each other may be observed, and a clue thus obtained, by which the common cause operating on all, may be at length discovered as the leading member of this class, and the head under which the others are to be ranged may be placed.

(1). The phenomena of dykes, observed under different circumstances, both in the volcanic rocks of the present, and in those of past eras. By a fair and close induction from observed facts, geologists universally agree, that these rocks were originally ejected in a fluid, or viscous state, and have gradually assumed their present hard, and compact nature, as they parted with the temperature they then possessed.

(2). The slates of Cumberland and Wales, described by Prof. Sedgwick, the analogy between the peculiarities of whose structure, and those of the trap dykes, has already been noticed, belong to a class of rocks, to which Mr. Lyell has applied the term " metamorphic; " such rocks, this eminent geologist considers, to have a sedimentary origin, being originally deposited from water, but subsequent to their deposition, he conceives them to have been modified and acted on by internal heat. Whether that heat was sufficient to reduce them to the fluid state, so that polar forces might act with greater freedom, is, as will afterwards be proved, a question of little, or no importance, as bearing on the present enquiry. It is sufficient for this, that heat should have been in action at all, its intensity being of comparatively little consequence.

(3). Intimately connected with the two preceding classes, are the phenomena exhibited by altered rocks, or those in the immediate vicinity of decidedly volcanic products. These rocks are sometimes in actual contact with the originally fused masses, as when they form the walls of a dyke, and then at the planes of junction on both sides and to some distance beyond them, phenomena analogous to the preceding are

most commonly met with—Chalk in the vicinity of basalt, is known to become beautifully crystalline: the crystallization being most perfect, in the immediate neighbourhood of the altering rock, while it becomes gradually less and less distinct as we recede from this. Numberless instances similar, and even more striking, than the above might be adduced, the facts however are so familiar to every geologist, that I do not consider it necessary to advance more; in all, however, this is observed, that crystals only appear in those localities, affected by the dyke. The sienite, including the trap dykes of Amboor, exhibited no signs of alteration; but this is by no means an uncommon circumstance, and it finds a ready explanation, when we bear in mind, that the original temperature of injected rocks may vary considerably, and also that the conducting powers of different rocks, on which their susceptibility of alteration materially depends, are also very variable; from these two causes, it may frequently happen, that certain rocks exhibit no signs of alteration, under circumstances apparently similar to those of others, in which these signs are strikingly apparent.*

The three preceding classes belong peculiarly to the province of the geologist, all being taken from his particular science. Now in this, it most frequently happens, that effects only remain to us, the causes to which these are due having ceased to act; it therefore becomes necessary to advance with caution, in our enquiry as to what these causes may have been, and rigidly to examine and verify each step we take. Hence, then, it is very natural for us to enquire, if there is a possibility of producing effects analogous to those observed in the natural world, while we can watch also the cause in operation to produce them. This remark leads us to the consideration of a fourth class, by which some additional light is thrown on the enquiry.

(4). In this class, I purpose including the results of the researches of several eminent chemists, on the production of crystals, similar to those occurring in nature, through the agency of heat, of greater or less intensity. Among these, Mitscherlich of Berlin has been the most successful, and to him we are indebted for a large proportion of the new and interesting information these researches have furnished. Having by careful analysis, made himself acquainted with the proportions, existing between the component parts of different minerals, he formed a mixture, in which these were retained, and after exposing this to the

* On examining the sienite of Waniamboddy in which trap dykes are also abundantly met with, I was equally unsuccessful in my search after signs of alteration. Benza however mentions having met with them occasionally. In Antrim, Isle of Anglesea, &c. these alterations are remarkable.

action of a furnace till fusion took place, when it was removed, and allowed to cool, he thus obtained, synthetically, those very minerals, in a state quite analogous to that in which they had been found in the natural world. Having in this manner combined the elements of mica,* he succeeded in forming beautiful, and distinct crystals from them, in this case, finding it essential, that the fused mass should cool very slowly. This remark is very interesting as connected with the formation of sienite, granite, &c. in which mica occurs so abundantly. Similarly, having combined the elements of augite†, he succeeded in obtaining it in a crystalline form, more rapid cooling being requisite for it than for mica. This also is quite consistent with the observations of mineralogists, who remark that augite is always found associated with such rocks, as have experienced a rapid decrease of temperature. So material is the influence exerted by rapid cooling, on the nature of certain minerals, and especially on augite, that it is often the only cause of their differing from certain others. Thus in reference to augite, its composition, and many of its external characters, are precisely similar to those of hornblende, so much so, that Professor Rose of Berlin has proposed, to consider them as one and the same mineral.

Since hornblende enters so largely into the composition of all trap rocks, and especially abounds in the trap of Amboor, the following remarks, relative to the cause of the difference between it and augite, are very interesting :—" It is well known," says Allen, from whose useful work on mineralogy I quote "that augite and hornblende seldom occur together: and that when they do, it is in trachytic rocks and lavas of later date, in which the one forms crystals in the cavities, the latter, a portion of the mass. The frequency of augitic forms, and the non-occurrence of hornblende, among crystalline slags—the results of Mitscherlich and Bertheor's experiments in producing augite artificially, whereas they never succeeded in forming hornblende, and lastly, the general occurrence of hornblende, associated with quartz, felspar, &c., and such rocks as have experienced a slow decrease of temperature, while augite is always associated with others as olivine which are known to have cooled rapidly—all concurred, in leading Rose to conclude, that the crystalline form presented by each of these substances, depended entirely on the more or less rapid cooling to which they had been exposed. Upon fusing in consequence, a mass of hornblende in a porcelain furnace, he found that it did not in cooling, assume its previous shape, but invariably took that of augite." Such being the

* Buckland's Bridgewater Treatise.

† do. do. do.

case, Rose concluded they ought to be looked upon as the same, and included in one class; of the propriety of which step, the preceding remarks seem to leave but little doubt. These experiments are most interesting, when viewed as furnishing us with a standard of comparison, by which we may form some idea, of the different times required for the production of different minerals in nature. The rate of cooling may also be estimated, from the peculiar forms assumed by the minerals produced, as for instance, in the sienite, so frequently mentioned in this paper, the ingredients of which, the quartz, felspar, and hornblende, are all known to require slow cooling for their production; and, therefore, we conclude the sienite to have passed very gradually, from its highest point of temperature, down to its present state—similarly, with reference to the trap dykes under consideration, in which hornblende and mica prevail, substances also requiring slow and gradual cooling for their production. The earliest experiments on record, by which the connection between the crystalline structure, and the application of heat was exhibited, are those of Sir James Hall, in 1798: in 1801, Mr. Walt pursued the same subject in greater detail, while in our own day, Wollastone, Millen, and Haidenger, have been occupied in the same train of research. I do not intend to enter farther on this point, since enough has been adduced to prove the analogy subsisting between these operations of men in their laboratories, and those due to the action of the general laws by which God governs the material world, and which are included in the three first classes.

Now, the general and connecting link of the whole series of phenomena above described, is their dependance on the application of temperature, but, it will readily be observed, it is not so much on the absolute degree of this, to which the substances exhibiting them have been subjected, that the phenomena depend, as upon the fact, that the original temperature has undergone variations of greater, or less, extent. Had the original heat applied, remained the same, only the effects due to this would have been exhibited; as, for instance, if the heat had continued at the points of fusion, or of viscidity, the bodies, of course, would ever have remained in a fluid or viscous state: but, the gradual diminution of the temperature has given rise to new, and striking phenomena, dependant on it for their development, and following it invariably, as effects follow their cause. Assuming then for the present, that, as a natural law, including a certain series of phenomena, provided disturbing causes are not in operation, " signs of crystallization will follow on a body, kept in a fluid or partially fluid state by the action of heat, again becoming solid," it is natural for us to enquire if the law can be extended further, and be rendered more general in its expression, and application. And

first to show that neither fluidity, nor viscidity, are necessary for crystallization, I proceed to the consideration of certain facts included in class—

(5). In the collection of a friend, I had an opportunity of examining a fragment of sandstone, which had originally formed part of the floor of a baker's oven. On breaking up the floor for the purpose of repairing it, the whole of the lower portion of the sandstone was found most regularly, and beautifully crystallized, in prismatic columns of 6 or 8 sides, being the very forms so frequently assumed by basalt, and certain other rocks of igneous origin, and exhibited, on a gigantic scale, at the Isle of Staffa and the Giant's Causeway. The sandstone was I think about 2 or $2\frac{1}{2}$ inches thick, while the columns extended from a thin layer at the upper surface, of about $\frac{1}{3}$ of an inch in thickness, down throughout the remaining thickness of the mass. Looking at the exposed surface which formed the floor of the oven, no signs of the column beneath could be detected, and only when a fracture was made were they discovered. The sandstone was taken from a quarry, the rock of which was a member of the coal series ; its texture was close, and granular, and its general appearance proved, that though the heat to which it had been subjected, was sufficient to produce crystallization, it had not in the slightest degree, caused it to fuse. In farther illustration of this point, it may be stated, that Professor Mitscherlich found, on exposing prismatic crystals of sulphate of nickel,* in a close vessel, to no stronger heat than that of the sun, that, though externally unchanged, yet, on being broken up, were wholly composed of octahedrons ; while the same cause, changed, in a few seconds, prismatic crystals of zinc, also, into octahedrons. Crystals of sulphate of magnesia and of sulphate of zinc when boiled in alcohol gradually lose their transparency, and on being opened are found to be composed, internally, of numberless minute crystals, totally different in form from the originals. Most striking, indeed, are the views such facts give us of the state of the matter by which we are surrounded ; all seems in relative motion, and substances which to our senses seem as hard as adamant may, and indeed, judging from the preceding facts, actually are in a state of continued and increasing motion—who can say, but that the interior even of the diamond, excited by no greater cause than the warmth of the hand that wears it, would, were its particles and the effects produced upon them equally appreciable by our senses, exhibit a scene of as much turmoil, and change, as that produced by a

* Mrs. Somerville's Connection of the Sciences.

furnace, on the metal-filled cauldrons of an iron foundary, or on the water in the boilers of a steam-engine.

The further we advance, in our knowledge of the wonders of creation, the more reason do we find to adore the infinite power of that great, and glorious Being, to whom all is due: a power, of which we may form some slight idea, from the toil and labour required on our parts, to investigate those laws by which it works, when applied to the government of the natural world. Little cause is there for intellectual pride, when we reflect that the profoundest investigations, and the most refined systems of analysis adopted by mathematicians, the most extensive observations of the natural philosopher, reaching almost literally from pole to pole, or the most laborious researches of the chemist, all and each, are only, as it were, so many lines by which we are enabled to sound the depths of the power and wisdom of that God, who, by the simple expression of his will, called all those laws, as well as the matter on which they operate, into existence. The progress of discovery proves to us how little we *have* known of those depths; and gives to the following remarks of one, who, perhaps, if any human being could be entitled to glory in his intellect, to him the right would be conceded, a beauty and force, which make it one of the most striking on record.—" I deem myself," says Sir Isac Newton, to whom I refer, " to be like a little child playing on the sea shore—the waves every now and then washing to my feet a smoother or a prettier pebble, while the great ocean of truth is unexplored before me.''—I now return to the consideration of the classes which still remain.

(6) Since my attention was directed to collecting facts for this enquiry, I have been much interested by observing the regular forms, into which the fine mud, forming the bottoms of tanks and pools, divides itself, after the evaporation of the surface water. Whenever the surface of the mud is exposed to the heat of the sun, the outlines of the figures begin to develope themselves, and as the evaporation of the water combined with the mud proceeds, these outlines gradually become more and more distinct, till at length complete separation takes place, and the whole mass becomes divided into columnar prisms, of various sizes, and bounded by different regular figures—sometimes the bases are triangular, sometimes quadrangular, but the most generally prevalent forms are pentagons and hexagons. Both the sides and angles of the different prisms vary in these dimensions, as indeed might be expected when we consider how much the affinity of crystallization must be limited by the nature of the mud, and also by local circumstances, some portion being more freely exposed to the action of

the sun's heat than others, and the state of division in which the particles are, being also variable.

In the ditch of the fort at Bangalore, I found the general depth of the prisms to be about 4 or 5 inches; in one place however this was increased to as much as 8. Sometimes the lines bounding the figures are slightly curved, but these are exceptions to the general rule. In spite of the irregularity which modifying causes have produced on these forms, it is impossible to conceive they are due to simple mechanical contraction alone, and I cannot convey the view I am induced to take of their origin better, than in the language employed by Professor Sedgwick, relative to the analogous phenomena of the Welsh and Cumbrian slates. "We may safely affirm" says this eminent geologist "that no contraction of dimensions, no retreat of parts in passing from a fluid to a solid state, can explain such phenomena as these. They appear to me only resolvable, on the supposition, that crystalline or polar forces acted on the whole mass simultaneously, in given directions, and with a definite power." Similar appearances to the above are to be observed in the hard sun-dried soil so abundant in the neighbourhood of the cantonment of Bangalore; also traces are to be noticed in chunam which has dried rapidly, on being exposed much to the heat of the sun, combined with the occasional presence of moisture. There are certain peculiarities connected with this class, which, however, must be deferred, till the general enquiry is more advanced—and therefore I proceed to the consideration of the last of our series.

(7) This class will include certain phenomena which have been exhibited by ice during a thaw, and which are strikingly analogous to the preceding classes, thus extending the law of the connection of crystalline form with variation of temperature, to an extent which scarcely could have been anticipated. The phenomena referred to, are described by Col. Jackson in the Journal of the Geographical Society: Mr. Lyell, to whose work I am indebted for the account of them, quotes it to show, that the phenomena are analogous to those of certain igneous rocks, but he offers no explanation, and indeed says "this tendency to a jointed structure is by no means understood: but it appears, from recent observations, that ice sometimes presents a similar arrangement of parts. Scoresby,* indeed, had long ago, when speaking of the icebergs of Spitzbergen, stated "that they are full of rents, extending perpendicularly downwards, and dividing them into innumerable columns." Colonel Jackson has lately investigated the subject with more attention, and has found that the ice

* Arctic Voyages.

on the Neva at St. Petersburgh, at the beginning of a thaw, when two feet in thickness, is traversed by rows of minute air bubbles extending in straight lines, sometimes a little inflected, from the upper surface of the ice, towards the lower: at from two to five inches of which they terminate." Other blocks presented these bubbles united, so as to form cylindrical canals a little thicker than a horse hair.—Observing still further, he says, "I found blocks, in which the process was more advanced, and two, three or more clefts struck off, in different directions, from the vertical veins, so that a section perpendicular to the veins would represent in miniature the star-formed cracks of timber. Finally, in some pieces these cracks united from top to bottom of the veins, separating the whole mass into vertical prisms, having a greater or less number of sides. In this state a slight shock was sufficient to detach them: and the block, with its scattered fragments, was in all respects, the exact miniature resemblance in crystal, of a Giant's Causeway. The surface was like a tesselated pavement, and the columns rose close, adhering, and parallel, from the compact mass, of a few inches, at the lower surface—more or less time is required for the process, which I have seen in all its different stages." This, as well as the preceding class confirm a remark previously made, namely that the phenomena in question depended essentially on variation of temperature, and it matters not whether this variation is caused, by the bodies losing, or gaining heat, as may readily be observed by comparing the circumstance of the different classes with each other. In the last case, the phenomena are first observed when a thaw commences, and their development keeps pace with the progress of this, so that their connection with the variation of temperature, during the passage of the solid ice into water, is thus evidently seen. In the former classes the variation was consequent on the passage of fluids into solids, and was therefore dependant on the obstruction of heat—in this it is exactly *vice versâ.*

Having, in the preceding seven classes, included all the phenomena analogous to those of the trap dykes of Amboor, with which I am acquainted, it now becomes necessary to consider with more care, and in greater detail, the mutual connection that subsists between them all—so that, if it be possible, we may by this means be led to some more definite ideas of the cause to which they are due, than we can now have.

Varied as the circumstances of the different cases have been, attention has occasionally been directed to that one point, in which all, without exception, have been found to agree. Now, it is a rule in enquiries of a

nature like the present, if we find that "in our group of facts there is any one circumstance in which they all without exception agree, that circumstance *may* be the cause in question, or at least a collateral effect of the same cause, if there be but *one* such point of agreement, this possibility becomes a certainty, and if on the other hand, there are more than one, they may be concurrent causes*."

Looking then to the group here assembled, we find that their subjection to a variation of temperature is the single point, in which they all agree ; this, therefore, according to the above rule, given by Sir John Herschel, must be, either the cause itself, or intimately connected with the cause. We now proceed to examine this point, and in order that the results may be more clearly exhibited, one instance will be taken, and the various circumstances connected with it examined and discussed. Selecting, then, for this purpose, the trap dykes—we know, from generally acknowledged geological theories, that the trap of which they are formed, was originally ejected from the interior of the earth, at a temperature so high as to be kept by it in a state of fluidity similar to that of the lava currents of existing volcanoes. Let us therefore suppose we have before us a formation of this kind, an intensely heated and fused mass, included between two walls formed by the fissured rock. From the action of that law, by which bodies tend to an equalization of temperature, the moment contact was made between the heated trap and its including rock, an abstraction of caloric from the former by the latter would take place, and as the heat travels slowly from particle to particle of the including rock, to distances dependant on its conducting power, a continual demand is made on the trap, so that we may conceive two currents to be established flowing from each side of the dyke through the adjoining rock forming its walls. Now it is a singular fact, and one by which this enquiry is most materially advanced, that, under circumstances precisely similar to those under which the trap is here described as being, a combination is formed, by which large quantities of electricity are developed, and this development seems to be an effect of the variation of temperature. Hence, then, the idea that the cause we are in search of is this variation, becomes merged into the more definite one—that electricity in the active and operative agent, to which we are to attribute the phenomena whose production we are investigating. In electricity we have all the essential requisites for a cause by which natural phenomena may be explained, we know of its existence, of its be-

* Sir J. Herschel's Discourse on Natural Philosophy.

ing what Newton calls a "vera causa,"* we have examples of the effects it produces as an agent in natural operations ; we may therefore safely reason about its efficiency in this case, and if we are supported by strong analogies derived from its "modus operandi" in other instances, we may be allowed to infer its being the active agent in this, since, to use the words of one† well qualified to judge, "we are not to deny the existence of a cause, in favour of which we have the unanimous agreement of strong analogies, though in the particular case it may not be apparent how the cause produces its effects."

These remarks naturally lead us to the more detailed examination of the cause, to which, from a discussion of the assembled group of phenomena and the application of special rules to these, we have been led—and first, we may establish the fact of its existence under circumstances like those of trap dykes, to which we still adhere as the representative of the others. The discovery that electricity might be excited by the partial application of heat to a circuit, into which no fluid entered as an elementary part, was made as early as 1822, by Professor Sæbeech of Berlin.‡ He employed a single bar of antimony, and having wound round the two extremities of this several coils of brass wire forming the poles, he applied the heat of a spirit lamp to one end of the bar—immediately a current of electricity was established, of intensity sufficient to affect most sensibly the needle of a galvanometer, placed under the circuit. This discovery of what has been called thermo-electricity (from the cause of its development) excited much interest, and the subject was pursued with great zeal, so that the thermo-electric relations of numerous substances were determined—all that seemed essential to the exhibition of these, was, that one part of the circuit should have a higher temperature than the other—the immediate consequence of which was, the determination of an electric current in a direction from the hot part towards the cold. There is no necessity for the substances employed being metallic, for M. Nobili§, a Florentine philosopher, has lately produced electric currents, by the contact of two pieces of moist clay, one

* Professor Whewell in his "History of the Inductive Sciences" questions the right of electricity to be considered a "vera causa," on the ground of its not being a physical reality, but due to the vibrations of an etherial medium. I use the expression without any special reference to the nature of electricity, of which we know so little, but simply as a means of conveying the desired expression as to the propriety of reasoning concerning its operations in the natural world.

† Sir J. Herschel.

‡ Dr. Roget's Treatise on Electro-Magnetism.

§ Mrs. Somerville's Connection of the Sciences.

of which was hotter than the other. I cannot pass by this curious experiment, without attracting attention to the interesting bearing it has upon the phenomena of the clay and mud, previously described under class 6. The circumstances of each are exactly similar, for, it will be remembered, the phenomena I described followed the evaporation of the water mixed with the clay, and it is most natural to suppose, that the sun's heat would not operate on every part with the same degree of intensity; hence then we have the exact arrangement of Nobili's experiment viz. moist clay, of variable temperature, in contact throughout. We may therefore conclude, that electric currents would traverse it. Further on this point, it is known, that evaporation is itself one of our most fruitful sources of electricity, and if the water evaporated holds any substance, either earthy or saline, in solution, the quantity of this is proportionally greater; the currents circulating through the clay would thus be increased in quantity, though their intensity would be small: but, as will be afterwards proved, this is the state best adapted for producing those effects attributed to them in this paper.

To prove further that it is a matter of indifference whether the circuit gains or loses heat, provided only that variation takes place, I may give a hasty sketch of some observations made on this subject* by Oersted, the celebrated discoverer of electro-magnetism. He made a hexagon, the alternate sides of which were antimony and bismuth, the two metals whose junction gives rise to the strongest currents. First he heated one of the soldered angles, and immediately the galvanometer needle was deflected, when two alternate angles being heated the deflection became greater; and greater still, when the spirit lamp was applied to three. Changing his plan, he reduced the temperature of one angle by means of ice (doing which was vertically raising the opposite) and, as might be anticipated, the needle was again most sensibly affected. On applying temperature to these alternate angles, and ice to the intermediate ones, Oersted obtained the greatest effect from the currents—thus shewing that the intensity depended on the difference between the respective temperatures of the elements of the circuit. Mr. Becqueral arrived at a similar result, finding that the intensity increased with the heat, though a limit seemed ultimately to be put to the law, varying in different substances. To shew that the electricity derived from the above sources is identical both with that from the machine, and the galvanic pile, I may mention, that one Italian philosopher has succeeded in decomposing

* Dr. Roget's Treatise on Electricity.—Society Useful Knowledge.

water and several solutions by its means, while another has produced from it a clear and distinct spark.

Sufficient has now, I trust, been said, to establish satisfactorily the development of electricity under circumstances analogous to those of trap dykes. In the latter there is every essential for such an effect, the original high temperature of the injected trap, the consequent abstraction of its heat by the including rock, in which the temperature was much lower, are in themselves the elements of thermo-electric currents, and a remark due in common with many others of a like nature, to Dr. Faraday, " that when a solid which is not a metal becomes fluid it almost entirely loses its power of conducting heat, while it acquires a capacity for conducting electricity in a high degree," proves to us how favourable their original state was, for being traversed by currents thus excited. Indeed from views which have thus gradually, and step by step, developed themselves during the progress of this enquiry, I cannot but look on trap dykes as being essentially electrical machines, developing continued currents of electric energy during the time that their temperature remains above that of the including rocks—these currents, following the law of intensity formerly announced, being proportional to the difference of temperature between the elements of the circuit. Viewed in this light, trap dykes contain within themselves both the agent, and the substance acted upon, the electricity developed during the process of refrigeration being the one, the constituents of the mass the other. The preceding form another of those many links by which heat and electricity are connected, and though confessedly this bond yet remains enwrapped in mystery, the time seems not far distant when greater light will be thrown upon it, as analogies are becoming stronger and stronger, and materials for the discovery, we might almost say, of their identity are rapidly accumulating. It would be quite foreign to our subject to digress on this point, I would therefore now offer a few remarks on the efficiency of the cause to produce the effects I have attributed to it, and enquire into the connection subsisting between electricity and the phenomena of crystallization; our enquiry must here be exclusively analogical, for it is only thus we are permitted to conduct investigations like the present, where effects remain after the cause to which they are due has ceased to operate.

Electricity, as known in the natural world, may be considered as of five kinds, to which the names, common, voltaic, magnetic, thermo and animal electricities have respectively been given; now one of the triumphs of modern science has been to establish, beyond a doubt, the identity of these varieties, by clear and distinct proofs. Similar effects have been produced by all; composition and decomposition, deflection

of the needle, and the obtaining of sparks, are the chief links of that chain which binds them to one common source. The last to which this has been extended is the animal electricity, or that derived from those animals, as the torpedo, to which God has given the power of administering shocks, as their weapons of defence. Professor Linari of Sienna has obtained both the direct and the induced spark from the torpedo, and Dr. Davy has decomposed water by its means. " It has been further proved, that the apparent differences are due to the peculiar state in which the electricity respectively exists, with relation both to its quantity and its intensity." Now, according to Dr. Roget, these states are three in number, first the state of highest tension, or that in which electricity derived from the common machine exists, when it accumulates till its force is sufficient to enable it to make its way through the air, which is nearly a perfect non-conductor. Second, in a similar degree of tension as when derived from the galvanic battery, where the path is more open to it, and therefore it does not accumulate so much as in the common battery. The metallic parts of the galvanic battery are good conductors, but the fluid ones are not so easily traversed, the quantity circulating is therefore greater, though its intensity is smaller than in the preceding case. Third, in the smallest of all degrees of tension, as in thermo-electric currents, throughout the whole of which no impediment to the free passage of the electricity is met with, the circulation taking place, as it were, from particle to particle, without any non-conducting medium being interposed as in the two first cases. The peculiarity therefore of thermo-electric currents is, that while their intensity is next to nothing, the quantity is comparatively very great. Now it will be considered as a striking fact in connection with this enquiry, when it is known, that batteries whose principles of action are the closest possible to those of thermo-electric circuits, have been extensively used as the means of producing crystillization in a very great number of bodies. Those singular experiments due to Mr. Crosse, and which, from the sensation they excited, are still doubtless fresh in the memories of all, were performed under the circumstances above referred to. Feeble currents, derived from batteries excited by no stronger agent than pure water, but continued for a long time, were the means in operation by which crystals of quartz, arragonite, carbonate of lead, lime and copper, &c. were produced. These experiments I partially repeated some time after their announcement with most satisfactory results. I employed more powerful batteries, and obtained crystals more rapidly, but these are never so perfect as when formed by long continued action. Mr. Becqueral, who has with much success pursued this new path, found that years

were required for the production of some crystals. I believe this philosopher has been the means of forming a Company at Paris, for the purpose of obtaining certain precious stones by the above means, in which I am told by a gentleman who saw them, they have so completely succeeded, that the rubies of the Company could not be distinguished from those of the jeweller. Now I cannot but consider it as strikingly confirmative of the view I am inclined to take of the cause to which the crystalline structure of the trap dykes, &c. is due, that the electric action in them is so precisely similar to that in the above cases. It is even more favourable in the dyke, for the circulation of the currents is more free, especially at first; of course as solidification progresses this is diminished, but this process goes on very slowly, as is proved by lava currents retaining their heat for such immense lengths of time, when the upper surface becomes solid, so as to oppose the further abstraction of heat.

It is further interesting to learn that already have electric currents been detected in metalliferous veins, as by Mr. Fox in those of the Cornwall mines; and though the electricity generated seems more due to chemical actions between different materials in the vein, than to any variations of temperature, still we know the identity of the two kinds, and therefore if one produces a certain series of effects, it is natural to conclude the other would do so likewise. Of Mr. Fox's experiments by which he was led to the above discovery, Professor Wheatstone remarks "the value of these interesting researches consists, in the exact analogy they bear to what actually takes place in mineral veins;" and the result proved how true this remark was. The details of these experiments are now before me, but I do not consider it necessary to enter into further detail on this point, as I trust analogies sufficiently powerful and numerous, have now been brought forward to demonstrate the efficiency of thermo-electricity to produce the phenomena as observed in the structure of trap, and also in other rocks placed under analogous circumstances.

This principle of explanation will readily be applied to all the classes forming the ground work of this enquiry, which here might fairly be brought to a conclusion, since of the peculiar manner in which electricity acts in producing crystallization, little or nothing is known. That it does do so we have seen, and beyond this all is comparative uncertainty; it is therefore with most unaffected diffidence that I venture to offer a few remarks grounded on what is known on this subject, as I can scarcely deem my enquiry complete till such an addition has been made to it. I feel my incompetency to do any thing like proper justice to this question, yet as some interesting information, though small in quantity,

has been collected, I will conclude this paper with a few observations deduced from it.

Crystallization being an arrangement of the ultimate particles or atoms of the crystallized body, according to certain definite laws, it is thence evident that these atoms are of determinate bulk, and that matter cannot in consequence be regarded as infinitely divisible, but must ultimately arrive at a limit. What this limit is we know not, but when it is attained, the atoms have also determinate figures, as well as bulk; for it is known, that certain crystals can only be built up complete by the continued addition of those elements whose form is fixed. Magnitude and form necessarily imply density, and it is known that the particles of a body, however dense that may be, are not in actual contact, but are separated from each other by indefinitely small spaces. Now, considering electricity as a fluid of the highest state of elasticity, M. Mosotti of Corfu conceives, that these minute spaces are filled with the electric fluid, so that each particle is confined within an atmosphere composed of it. Further, and as consistent with the general phenomena of electricity, he conceives that the atoms of the fluid repel each other; the molecules of the matter also repel each other; while there is a mutual attraction between the particles of the fluid and of the matter. Few indeed could follow the refined and elaborate analysis by which M. Mosotti has succeeded in adjusting these forces, but we can all understand and follow the conclusions at which he has arrived. He has proved that *within* certain limits the particles of bodies repel each other, the force of repulsion diminishing rapidly as the distance increases—*beyond* a certain limit the force becomes attractive, and hence there must be some point at which equilibrium between these two forces exists, and there is then no tendency either to repulsion or attraction; if therefore we attempt compression, the repulsive force resists, if we attempt disruption, the attractive force or the force of cohesion then comes into play. The limit at which the negative force becomes positive varies according to temperature, and to the nature of the molecules, and determines whether the body is to be solid, fluid or aeriform. Beyond the neutral point, the attractive force increases till it attains a maximum, and then diminishes, till as soon as the particles are separated by sensible distances it varies directly as the mass, and inversely as the squares of the distances—the well known law of universal gravitation.

Such are the results of M. Mosotti's profound investigations:—applying them, therefore, to the case before us, viz. crystallization, it is evident, that the form of the ultimate particles would materially influence the direction of the attractive and repulsive forces, and hence arises our con-

ception of the polarity of matter, an instance of which in a great scale, is given in the case of the magnetic needle, the polarity of which is now considered due to its electrical condition. Now the phenomena of crystallization entitle us to infer, that there is something like a definite polarity in every particle, by which it is compelled to turn in a given direction, and to group itself with other particles in definite forms—the polarity in the "glaring instance" is due to electricity—may we not reasonably, from the above remarks, infer the same cause, to produce a like effect, in an instance, less under the immediate cognizance of our senses.

By reference to some observations I made about a year ago,* I find a remarkable illustration of the above opinions, noted as having occurred during the crystallization of fused sulphur. On the vessel, in which the sulphur was melted, being removed from the furnace, and allowed to cool, the upper surface of the mass became covered with thin needle shaped crystals, about one-eighth of an inch in length, and about the thickness of hairs. To these crystals, it seemed as if a power of spontaneous motion had been communicated, since they flew about in all directions, first from one side of the vessel to the other, then back again, then across, and indeed they kept unceasingly on the move. On close examination, I found all the phenomena of polarity exhibited by these small bodies toward each other, and on watching two, I observed them gradually approaching each other, till they almost seemed in contact, then, suddenly, both started back from each other to some distance. Turning round they approached each other again, apparently with those sides turned towards each other, which admitted of the attractive force coming into play, for they would rush together, and form what then seemed to be but one crystal. This process was going on throughout the whole, and this alternate advancing and retreating was the cause of the incessant motion. The forms of the acicular crystals were quite different from those resulting from their continued aggregation, the one being long and thin, the other, bright prisms of nearly equal length and breadth, and from one-quarter to half an inch in thickness. This remark is quite agreeable to the researches of crystallographers, who have found that such thin crystals following certain rules of superposition and ranged in a certain order, produce others of entirely different forms.

I will not enter further upon this point, but I trust the few remarks I have made will not be altogether devoid of interest, shewing as they do, the connection subsisting between the electrical condition of the parti-

* These were made in the laboratory of Mr. K. T. Kemp, to whom I believe the credit of having first remarked the singular phenomena is due.

cles, of a body, and the arrangement of these particles in their definite forms, a point of so important a bearing on the nature of this enquiry.

At a future time, I trust to be able to add one more link to the chain of reasoning, by which the preceding results have been arrived at, by giving the details of a series of experiments on the effects of electrical currents passed through bodies in a state of fusion, from which I anticipate additional confirmation to the foregoing view of the cause to which the crystalline structure of trap, basalt, and other rocks of igneous origin is due, as well as that of certain sedimentary deposits, acted on, and altered, by heat of variable intensities.

Perhaps it may now be advisable to cast a retrospective glance at the ground over which we have passed, and to exhibit, by a short recapitulation, the steps of our enquiry, so as to enable the memory to retain the leading points the better, by divesting them of the intervening details. The object to be attained was to determine, as far as we could, the cause of the crystalline structure of trap and other igneous rocks. To this end analogous phenomena were classified, and discussed, their general bearing in regard to each other exhibited, and the bond of union, the point in which they are all agreed, was, in obedience to the laws of induction, considered as either the cause itself, or intimately connected with the cause of the phenomena in question. A law, based on the facts reviewed, was there expressed, at first limited in its application, but subsequently extended, by the discussion of other phenomena, till, commencing with masses in a state of intense heat, it gradually descended till it was found to apply to frozen water. The law of the connection of crystalline forms with variation of temperature, as exhibited in the 7 classes, was then more minutely examined, and, by its extended discussion, variation of temperature was found to be a fruitful source of one of the most active secondary agents in the natural world, viz. electricity. The peculiar case of trap dykes was chosen to illustrate the action of this power, into which the original one was now resolved. Its development, its efficiency, and its mode of action, were successively examined in detail, and analogies were brought to bear on these different points. The field of inquiry is yet far from being exhausted, the dependance of crystalline form on chemical composition as exhibited in the laws of isomorphism, the resolution of chemical action into the preponderance of different electrical forces, as lately proved by Dr. Faraday, the connection subsisting between heat, light and electricity, are all paths open to and inviting research, full of interest, and promising most rich and fruitful returns.

In conclusion, it may be permitted me to remark, that, in seeking to extend the domain of a power already so universal in its agency, so extraordinary in its nature, it is impossible to refrain from oft times having the heart raised to that God whose handy-work we are investigating, and to whose name I would desire to ascribe that tribute of praise, too often, I regret to say, withheld by many who devote their talents and time to laying open the secret laws by which He governs the world in which we dwell. It gives us no mean idea of his power to mark, how, with one instrument, such varied, such numberless effects are produced. Nor is this idea diminished, when we examine the nature of the instrument itself, and find it so worthy of an Almighty hand. Traversing space with a duration less than the millionth part of a second; passing through solid bodies more rapidly than light travels through the regions of the planets;* at one time rending rocks asunder, at another the obedient slave of man; contributing both to his wants, and his pleasures; residing in the magnet, it guides the sailor on his pathless way, labouring in the caverns of the earth, it is daily producing more abundant supplies of the various metals so necessary to man's social comfort and earthly happiness; nay, some would even lead us to suppose, that it is the great link by which world is bound to world, that the great principle of gravitation is to be merged into the still greater one of electrical action. Be this as it may, electricity is, even supposing it false, an instrument sufficiently wonderful to lead us to admire and to glorify Him by whom it was created, and by whom it is now directed in all its vast and varied operations.

* Such are some of the striking results to which Professor Wheatstone's researches on electricity have conducted him. I am indebted to Turner's Elements of Chemistry for a short account of these, Mr. Wheatstone has found—

(1) That the velocity of electricity along a copper wire exceeds that of light through planetary space.

(2) The light of electricity of high tension has a less duration, in passing as a spark, than the millionth part of a second.

In a letter to Dr. Buckland, Mr. W. says, in reference to the economical applications of this power, "it requires not the tongue of a prophet to foretel that the voltaic pile will hereafter create as great a revolution in our chemical manufactories as the steam engine has already effected in the mechanical arts."—Bridgewater Treatises.—*Notes*.

V.—*Notice of River Dunes on the banks of the Hogri and Pennaur.*—*By* Lieutenant Newbold, a. d. c. *to* Major General Wilson, c. b.

Passing through Honoor, a village about 20½ miles S. by E. from Bellary on the Bangalore road, I observed small ranges of sand hills, covering the black cotton soil to a considerable extent, that had very much the appearance of the dunes on the Malabar Coast. Not recollecting the vicinity of the Hogri river, I was at a loss to account for their appearance in this locality; but, on ascending one of the highest, I perceived the wide sandy bed of the river at a considerable distance to the west. This, and the clouds of sand blown in my face, were now sufficiently indicative of the cause of the elevation of these ambulatory hills. The direction of the ridge on which I stood was nearly north and south: it ascends from the west, *i. e.* from the river, in a broad sweep of drifted sand, covering the intervening land for nearly a mile, and terminating in a rather abrupt and steep descent, which falls to the east. This line is by no means regular; as the arenaceous phalanx advances most in those parts, where there is least obstruction from vegetation. One of these advanced dunes I observed, in the act of crossing the dry bed of a nullah. Many of them are prevented making progress by the embraces of the long fibrous plants that have grown up, and are interwoven with their substance: the *kaki beyru,* and *jihar chettoo* are the plants usually seen in this situation. Small fresh-water shells, principally univalves, have been carried along with, and imbedded in the sand: the wind has left ripple-like marks on its surface, and it only requires consolidation to transform the sand of yesterday into a rocky fossiliferous ridge.

On arrival at Honoor, the following information was given me by the head-man, and some of the oldest inhabitants of the place. The sand hills advance in an easterly direction, every year, during the months of June, July and August, when the western winds blow strongest. On an average they progress two, or two and a half yards annually. About eight years ago, when the rain was scant, and the wind unusually high, one of these dunes advanced on, and buried land under cultivation to the extent of more than eight chains, which has not since been reclaimed. During the famine about seven years ago, the dunes threatened to overwhelm Honoor, and the sand actually rose in the streets to the height

of five feet. In order to prevent the recurrence of such a disaster, the villagers allow the intervening *babul*, and other trees to grow, which they were formerly in the habit of cutting down. The present distance between the nearest sand-hill and the village does not exceed more than 400 yards. In the memory of the oldest native of the spot, the sand was confined to the immediate vicinity of the river banks: he attributes its advance to the cutting down of the jungle, and the comparatively dry seasons that have since prevailed.

The village of Bodurti, in the Conigul district, about three koss hence, was totally overwhelmed about 10 or 12 years ago. I visited the site of this village, and found it, with the exception of a foot or two of the old walls rising above the sand, completely buried under a large dune. The expelled inhabitants have built another village, not far from the site of its predecessor, whose name it now bears. I have met with sand dunes on the banks of the Pennaur in the Cuddapah district, and have ridden over the remains of an old village and pagoda, in the vicinity of Jummulmudgoo, now completely covered by the sand. They occur also on the Malabar Coast, and contribute greatly to the formation of those singular lakes of sea and fresh-water, termed back waters. These sand hills resemble the dunes extending from the mouth of the Garonne to the district of Bayonne, described by De la Beche, blown up by the westerly winds, and preventing the drainage of the country, and forming marshes in their rear. It would be worth while to examine the deposit now forming in the Malabar back-waters. In those of the Garonne are often found alternations of marine, fresh-water and terrestrial deposits.

VI.—*Extract of a Letter from Captain* J. A. Smith, *Civil Engineer 1st Division, dated* 3d *April* 1839, *on the Table land of Cumbaucum Droog.*

(Communicated by the Madras Government.)

I have visited and examined the table land in the vicinity of the Pulicat lake, described by Lieutenant-Colonel Monteith in the Madras Journal of Literature and Science, No. 12.

The hill on which this table land is situated is part of a ridge connected with the eastern range of ghauts, and is known by the name of Cumbaucum Droog, the inhabited spot adjoining to it being a village in the Calastrie Rajah's territory, called Tallaripett, distant about 10 miles from the Pulicat lake, the nearest points of which are at Tudda and Bolingarpollium, both situate on the high northern road.

From Tallaripett the distance is about three miles, the road winding through a thick jungle to the foot of the hill. The ascent is irregular and in some parts steep, but although there is no formed road there is little difficulty in reaching the table land, which may be done on foot, or even on horseback. The length of the ascent is about four miles.

On completing the ascent, a comparatively level surface, of fully two square miles in area, is met with, the general appearance of which is that of a flat basin surrounded by bluff ridges in every direction, and intersected by ravines. The soil appears to be good and is said to have been productive and fertile, there are traces of cultivation, and the ruins of a pucka building were pointed out to me.

On my first visit to this spot on the 8th ultimo, a series of barometrical observations was made for the purpose of ascertaining the height of the table land above the level of the sea, the result of which gave an altitude of about 1650 feet; that of the nearest adjoining peak to the eastward of it, being nearly 1900 feet.

On a subsequent visit on the 28th of the same month, a fresh series of observations gave the altitude of the table land nearly 1700 feet, and that of the highest of the surrounding peaks, viz. of one distant about three miles to the south-east of the ruins before mentioned, about 2300 above the level of the sea. On the first visit the thermometer in the shade of a tree stood at 80° to 81°, at 10½ and 11 A. M., a strong southerly wind prevailing at the time, and the sensation to the feelings being cool and

agreeable. On the 28th a dry hot wind was felt at intervals, and the heat was very oppressive; the thermometer standing at 98° and 99° at noon in a tent, and the air being parched and scorching. The water, however, procured from the reservoir in the bed of the torrent, which passes down a ravine intersecting the table land, and which being supplied from internal springs may be considered to represent the average temperature of the spot, was found, even in the latter visit (the 28th), to possess a temperature of only 64°; so that the occurrence of the extreme hot weather then experienced is the more remarkable, and may be perhaps an unusual circumstance.

The supply of water appeared to be abundant, and it was of a limpid clear appearance. It is also considered of good quality by the natives in the neighbourhood, but various streams which I tasted had all a bitter taste, which was accounted for by the natives from the circumstance of the water-courses being choked with leaves and vegetable matter, and it is not improbable that that objection would be obviated by clearing them out, or by deriving the supply required from wells.

The fact that this elevated region is not exempt from the occasional influence of the hottest winds, may perhaps be considered likely to defeat its usefulness as a sanatarium for invalids; and to take away considerably from the beneficial effects which its bracing atmosphere might at other seasons offer.

V.—*Fifth Report of Progress made in the Examination of the* Mackenzie MSS., *with an Abstract Account of the Works examined.—By the Rev.* William Taylor, *Member of the Madras Literary Society, &c.*

A.—TAMIL.

a. Palm-leaf Manuscripts.

1. *Cási-Cándam*, or the section of the *Scánda purâna* which relates to Benares.

No. 9—Countermark 51.

This is a large manuscript, though forming only a part of the *Scanda purana.* It is written in the kind of Tamil verse termed *Viruttam*, a difficult kind of measure. Its translation into this metre is ascribed popularly to *Ádi-vira Pandiyan*, which is the case with several other works, too numerous to be probable; except possibly as regards patronage of the different authors. But the ascertained fact, that the College at Madura was founded with a special view to the transfusion of Sanscrit works into Tamil, and for the spread of the *Hindu* religion in the extreme south, may account for many dedications or ascriptions of works to one king. There is a reference in this poem to the passage of the *Vindhya* mountains by *Agastya*, extravagantly hyperbolized, but the greater portion relates to the river, and *tirt'has* or pools, to shrines, and to the legends of individual devotees at Benares. The *Cándam* or book is divided into one hundred *Adhyáyas*, or subdivisions. A specification of the contents of these *adhyáyas*, with a brief occasional explanation may suffice as regards this document.

1. *Nareda's* inspection of the *Vindhya* mountain. *Nareda* taunted the *Vindhya* mountain with being inferior to *Maha-meru* in size, and also inasmuch as the sun turns round *Meru* in its course. The *Vindhya* mountain, feeling itself insulted, elevated its summit even to the skies.

2. The celestials visit to *Brahmas'* world. As the *Vindhya* mountain had obscured the light of the sun, the celestials went and complained against it to *Brahma*, who referred them to *Agastya.*

3. The visit of the celestials to the hermitage of *Agastya.* They made known to him the haughtiness of the *Vindhya* mountain.

4. The praise of matronly chastity. The celestials describe the wife of *Agastya*, as a pattern of matronly virtues

5. The visit of *Agastya* to the *Vindhya* mountain. *Agastya* went near to it, when it bowed down, and paid homage at his feet. *Agastya* said "I am going to *Pothaiya*, and until I return remain always thus", a command which could not be broken.

6. Account of the *Tirt'has.* The virtues of the river Ganges are stated, and those of many other rivers, and reservoirs connected therewith, of superior efficacy in the removal of crimes.

7. The praise of towns adjacent to Benares. These places have their excellencies declared.

8. The account of *Siva-janma* and *Yama.* The former was a royal devotee, at whose death *Yama* took his soul.

9. The visit to the solar orb. *Yama* took the said persons soul, and shewed it that world.

10. The visit to the world of the celestials. *Yama* shewed this world to the soul of *Siva janma.*

11. The visit to *Agni-loca. Yama* shewed to the disembodied soul the worlds of fire.

12. The visit to the quarter of *Nairiti*, guardian of the south-west.

13. The visit to the quarters of *vayavu*, and *Cavéra*, regents of the north-west and north-east quarters.

14. The visit to the world of *Isvara*, and *Chandra.*

15. The visit to the worlds of *Táraga*, and *Budha*, or the starry sphere, and the planet Mercury.

16. The visit to *Sucra-loca*, or the planet *Venus.*

17. The visit to Mars, Jupiter, and Saturn.

18. The visit to the regions of the seven *Rishis*, or the north polar celestial sphere, especially *ursa-major.*

19. The visit to the *Dhruva-mandalum*, or north polar-star ; the said visit, like the preceding ones, being performed by the soul of *Siva Janma* under the guidance of *Yama.*

20. Eulogy of *Dhruva.*

21. Apotheosis, or beatification of *Dhruva.*

22. Visit to *Maha-loca* and the four other superior worlds.

23. The coronation of *Vishnu*, as seen by *Siva-janma.*

24. *Siva-janma's* beatification. As this king had, during his life, been a great benefactor, and had abounded in liberality,so after his death

Yama took him on the long celestial pilgrimage* above intimated; at the close of which he obtained full beatification.

25. The visit of *Agastya to Subrahmanya.* On occasion of this visit *Subrahmanya* conducted *Agastya* through *Benares*, and explained to him its various distinguishing features and excellencies.

26. Eulogy of the female sex at Benares, by *Subrahmanya* to *Agastya.*

27. Eulogy of the Ganges; in the same way narrated.

28. The depositing of bones in the Ganges. If the bones of those who die be deposited in the Ganges, the beatification of the departed is assured.

29. The specification of the thousand names of the river Ganges.

30. The praise of *Váranasi* or Benares. The *morality* of this *adhyáya* is observable. A woman entertained an improper affection for her own son, who remonstrated, and denounced on her total destruction. But on her death, advice was given to cast her bones into the Ganges, at Benares; in consequence of which her soul attained to *Sverga.* Hence *Casi* acquired the name of *Varanasi*†

31. The manifestation of *Bhairava* a terrific form of *Siva.*

32. The manifestation of *Tandapàni.* A devotee paid homage to a form of *Siva*, and received favour from so doing.

33. The magnificence of *Casi*, declared to *Agastya*, by *Subrahmanya.*

34. The beatification of *Calavati.* The legend of a woman, who took permission from her husband to quit domestic life; and, going to Benares, acquired beatification.

35. The declaration of household order. This section relates to the duties of those not devoted to an ascetic life, or the *Grihasthas.*

36. The duties of the order of *Brahmà chari* or religious novice.

37. The excellencies of the female sex: a eulogy of their perfections.

38. The duties and deportment of the *Brahmanical* order.

39. The duties of alms giving, by householders.

40. The deportment of *Saiva*-ascetics: rules as to their diet, and general conduct.

41. The knowledge of fatal indications. Certain signs are specified, by which a person may know the near approach of death. In such

* In this extensive celestial tour, the narration of which occupies from section 9 to 24 there is a sort of wild sublimity; upon the whole very superior to some puerilities of Byron; written, it may be conjectured, under like inspirations. *See his Cain.*

† See Wilson's Sans. Dict. 1st edition, page 796, or 2d edition page 735 for the derivation of the name. The above passage would seem to indicate a different one.

cases, in whatever place he may be, he is recommended to repair to Benares, that he may thereby attain beatification.

42. Account of *Abimutesam.* This person by great devoteeism to *Siva,* obtained much approbation, and many secular advantages.

43. The story of *Tilotattan ;* in subject, resembling the preceding.

44. The magnificence of *Casi,* again declared.

45. The visit of ascetics to *Casi* for the purpose of obtaining beatification.

46 to 51. Legends of individual devotees, at *Casi.*

52. Account of *Brahma's* sacrifice.

53 to 57. Visits of deities to *Casi.*

58 to 85. Legends of individuals, and formation of images, bearing some of their names.

86. The sacrifice of *Dacsha.*

89. The same subject continued.

89 to 99. Different legends of individuals.

100. A brief repetition or summary ; and description of the homage paid to the emblem of *Siva.*

Remark.—From this very brief indication the prevailing inanity, and wiliness, of the work may be inferred. The *St'hala puranas,* or local legends, of most of the distinguished *Hindu*-fanes, are drawn up generally on the same model. The bearing of such documents on the explanation of manners, and mythlogy, is very important. As to history there is, I conceive, nothing in this document of any value.

Note.—The manuscript is of comparatively recent hand-writing ; remaining fresh and uninjured. It is entered in the Des. Catal. vol. 1. p. 166. Art. X.

The following are Tamil versions from the great epic poem the *Ramáyana.*

2. *Ramayana,* No. 1.—Countermark I.

This manuscript contains a copy of *Camban's Ramayanam,* down to the end of the fifth *Candam,* or book ; and by consequence including the *Bála—Ayódhya—Aranya—Kishkinda* and *Sundara*-books, or *Cándams.* So far the work is complete ; and so very slightly injured that it may be considered to be in good state of preservation. It is entered in Des. Catal. vol. 1. p. 163. Art. I.

3. *Yuddha Candam,* No. 2.—Countermark 2.

This manuscript, which is equal in size to the foregoing one, contains the sixth book in continuation of the preceding, narrating the war with *Rávana*. It is also in good preservation. With this book, strictly speaking, the work of *Camban* concludes. It differs, in some minor particulars, from the Sanscrit poem by *Válmica.*

It is entered in Des. Catal. vol. I. p. 164. Art. IV.

Remark.—The *Uttara Candam* or supplement is wanting in the above copy. That supplement relates to the ancestry and family relatives of *Rávana*. Tradition ascribes its authorship to *Otta Cuttan ;* but adds that *Camban* approved it, and incorporated it within his own work ; an addition which seems doubtful.

4. *Aranya, Cándam*, and *Kishkinda Cándam* or 3d and 4th sections of the *Ramáyana*, No. 4.—Countermark 2.

In this copy the 1st leaf, the 49th and a few leaves at the end, are wanting. The M.S. is very old, and much worn away at the edges ; having also one or two leaves broken; but it is untouched by insects. The necessity of restoration is obviated by the existence of a complete copy in No. 1.

This manuscript seems to be part of one uniform copy, together with the two following portions, which in every respect resemble it, in external appearance, in age, and in the hand-writing. Such being the case the copy wants the two first sections, or the *Bála*, and *Ayódhya Cándams.*

5. *Sundara—Cándam*, No. 5.—Countermark 3.

The copy is complete ; the leaves are a little injured, the M.S. being very old, but not to any serious extent.

Consequent on the above remark, the sixth section, or *Yuddha Cándam*, is wanting.

6. *Uttara Candam,* No. 3.—Countermark 5.

This copy is complete; very old ; and only slightly injured.

That this copy belongs to the preceding second series, is determined by its appearance, and general characteristics, which forbid its being considered as a supplement to Nos. 1 and 2. However being taken with 1 and 2, it forms a complete copy of the entire work ; and one copy complete, as to matter, I deem sufficient for the collection.

Remark.—I have been informed that a prose version complete was made of Camban's poem by *Srinavasa-pillai*, for R. Clarke, Esq. part of the expense having been borne by Judge Gwillim, and J. Gwatkin, Esq. I have not seen that version.

7. *Ramáyana váchya* a prose version of the *Ramayana*, No. 6.—Countermark 6.

In the title *Cavi* (or poetical) is added, but this is wrong, the whole being prose, of an ordinary kind. It is a rather large manuscript, in good order, and complete.

A man of the *Vaniya* class is said to have gone every night to hear the *Ramáyana* of *Válmica* recited and explained by a *Brahman*, according to the usual custom of such public recitations; and the next day to have written down the substance of what he had heard. By this means he completed an epitome of the original work; which hence familiarly acquired the name of *Válmica Ramáyana;* because following *Válmica* implicitly, which the poet *Camban* did not do. It is not requisite, I believe, for me to abstract the contents: a general notion of the story of the *Ramáyana* being, it is presumed, very common.

The book is entered in Des. Catal. vol. I. p. 165. Art. IV. as "a prose version of the *Ramáyana* attributed also to *Kamban;*" by whom attributed is not stated. The *Ramayanam* by *Camban*, is a first rate work; this one of very mediocre character and pretensions. There are two other prose versions; but neither of them by *Camban*, who was strictly and solely a poet.

8. *Ramayana*, another (incomplete) copy.

This book it may be supposed originally contained the whole of the second division of the *Ramayana*, or the *Yudha Candam*, and *Uttara Candam*, but in its present state it wants 199 leaves from the begining of the *Yudha Cándam*, and is thence complete to the end of the *Uttara Cándam*. At the close there is a superscription signifying that it was written, or compiled, by *Vasudeva-pillai* for Dr. Mitchell. The said *Vasudeva-pillai*, I am informed, was a schoolmaster at Tanjore.

This version, like the last mentioned copy (No. 6) follows the original of *Válmica*; but it is much more full. This imperfect manuscript is equal, in size, to the whole of the said epitome.

However apparently it belongs not properly to the Mackenzie collection. It has nothing whatever of the outward adorning bestowed on the Mackenzie palm-leaf MSS. is of the plainest possible appearance, has no label or number ; and none of the usual marks of having passed through the hands of Prof. Wilson ; only the name *Ramáyana* in Tamil letters written in ink, on one of the boards. Hence I look upon it as a MS. more recently introduced to the collection, by whom, or for what purpose, cannot be stated.

The following manuscripts are Tamil versions from the *Mahábharata.*

9. *Sabha-parva* the second book of the *Bharatam*, No. 46—Countermark 7.

10. Another copy, No. 47—Countermark 7.

Both of these manuscripts contain an inferior version of the above-mentioned portion of the *Mahabharata.* It is said to have been a production of one *Nangai*, a *Brahman* woman, and to be known familiarly by the name of *Nanga-páttu* (or the chant of *Nangai*). The versification is plain, and of common order, adapted to the comprehension, and pronunciation of women, and occasionally is sung about the streets in ballad style.

The first of the two copies is in regular and good order, and complete: the other copy is damaged and very imperfect, at the begining, but being part of the same work the damage is of no consequence.

What remains proceeds as far as to the sojourn of the *Pándavas* in the wilderness; and thenceforward is what is termed *Pulantaran dutu*, being an account of the sending of a son of *Arjuna* to the household of *Duryodhana*, and his deportment there. The former part seems to be only introductory to this latter portion, which latter portion is complete. By consequence this manuscript is improperly entitled *Sábha-parva* ; being a work differing from the *Bháratam.*

11. *Udyoga-parva*, No. 48—Countermark 48.

This book contains not only the whole of the above mentioned section of the Tamil *Bháratam*, but also a portion of the *Yuddha-parva*, down to the seventeenth day's combat. It has the appearance of age ;

but is in extremely good preservation. It is part of a version by *Vili-puttur-áluvàr*, and is commonly termed *Aluvàr pádal*; which version is esteemed the best of three others by *Hindu* poets. The inferior versions are by *Nala-pillai*, and by *Rangha-náthapuluvan*. This copy, it is scarcely necessary to add, is in elegant Tamil verse.

12. *Yuddha-parva*, No. 49—Countermark 6.

This manuscript contains the whole of the above mentioned section of the *Bhárata*, in an inferior kind of versification, by an obscure or unknown author. It is supposed to be part of a version made by some one of the *Paria* tribe, who are reported to have such a version among themselves.

One-half only of the book contains the said section. The other half is a portion of some work on medicine, by whom written is unknown. It is not complete either at the beginning, or end; and is damaged, by the edges of some leaves being broken off.

Note.—Six portions of the Mahabharata are entered in the Des. Cat. vol. 1, p. 165, art. vii. I do not find more than four MSS. now remaining.

12. *Hanumanta-pattu* a chant in praise of *Hanuman*, No. 204—Countermark 182.

This is a book, very small in size, and brief as to contents. It contains ten stanzas, as a eulogy of *Hanuman*, for the assistance rendered to *Rama* in the war against *Lanca*. The eight diminutive leaves on which the book is written are much damaged by insects.

There is an appendix of eight similar leaves, of which only four are written on; the contents being an unfinished poem in praise of a local goddess, termed *Periya-nayaki-amman*, in good preservation.

It is entered in Des. Cat. vol. i. p. 228, art. lii.

13. Trincomalee *St'hala puranam*, or legend of the fane at Trincomalee Nos. 17 and 18.—Countermark, 25 and 26.

It is termed *Arnáchella puranam* in the manuscripts.

It contain 12 *Sargams* or sections. A brief abstract is here offered.

1. The first *Sarga* has the usual invocations and eulogies, and announces the name of the writer or author, that is *Yellapa-Vádhyar* of the *Saiva* class, who states that he translates into Tamil, from the Sanscrit original by *Vyasa*. It was originally delivered by *Nandi* to *Márcandeya*, by *Márcandeya* to *Vyasa*, by him to *Suta*, and by *Suta* to the *rishis* of the *Naimisara* wilderness.

2. This section contains the legend on which the distinctive name of *Arnachellam* is founded. *Siva* appeared as a fiery mountain, and to settle a dispute between *Brahma* and *Vishnu*, as to which was the greatest of the two, they agreed to try if they could, to discover either the foundation or the summit of the mountain. *Brahma*, assuming the shape of a goose or swan, flew upwards, and *Vishnu*, in the form of a boar, dived downwards. The latter returned and stated that he had not succeeded in discovering the foundation, but *Brahma* came back and said he had seen the summit, bringing a flower* suborned to bear false witness. *Siva* in consequence doomed *Brahma* to be without fanes or worshippers, for his falsehood, and declared *Vishnu* to be superior to *Brahma*, though confessedly inferior to himself.

3. This section in the commencement narrates *Dacsha's* abuse of *Siva*; the sacrifice of *Dacsha* to which his daughter the wife of *Siva* desired to go, and going perished; in consequence *Siva* (it is here said) produced *Vira-Bhadra* from his frontlet eye, who went and destroyed the sacrifice returning afterwards to *Cailasa*. Subsequently, while *Siva* was performing severe penance, one *Sura-padma*, an *asura*, acquired so much power as to trouble both gods and men. Complaint being made to *Brahma*, he announced the future marriage of *Siva* with *Parvati*, and also the birth of *Subrahmanya* by whom the *asuras* would be destroyed. *Indra* sent *Manmatha* to destroy the penance of *Siva*, and *Siva* opening his frontlet eye reduced the assailant to ashes. Subsequently *Siva* returned to *Cailasa*, where the celestials represented to him the expediency of marrying *Isvari* the daughter of *Parvata-rayen* (or the mountain king) to which he consented, and the marriage was conducted with the customary state and splendour. At the prayer of *Reti*, *Siva* pardoned *Manmatha*, who came and paid homage without any visible form, in consequence of his body having been turned to ashes. The oppression exercised by *Sura-padma* being stated to *Siva* he produced six fires from his frontlet eye, by the union of which *Subrahmanya* with six faces was

* The Kétaki, or Pandanus odoratissimus: which, partaking of the curse, is never used by the Hindus in honouring the gods.—*Editor*.

born. He fought with and conquered the *asuras* and having done so returned to *Cailasa.*

4. After the marriage ceremony was over *Parvati* asked *Siva* what were the sun and the moon; he replied they were his two eyes; whereupon *Parvati* shaded both eyes with her hands; the consequence was universal darkness over the world; and all beings lost the use of their eyes. *Siva* incensed opened his frontlet eye, and dissipated the darkness. *Parvati* was doomed to do penance on earth, which she did under a mango-tree at Conjeveram, and there erected a small image of earth. She subsequently went on a visit to *Arnache'lam,* and thither *Gautama* the *rishi,* and others, inclusive of *Siva* himself, also came.

5. This section in the commencement relates to *Mayadasura* who in a former birth, for a fault committed, was condemned to be born as a buffalo. Acquiring great power *Isvari* sent for *Durga* to go and kill him. A combat took place in which *Mayadasura* * was slain. An emblem of *Siva* arose out of his remains. Subsequently *Siva* came to *Arnáchellam* on his bullock vehicle, and there incorporated *Isvari* into his own form, so that on the right side the form of *Siva* was presented, and on the left side that of *Parvati.*

6. This section contains the story of *Vajranga Pandiyan,* an abstract of which was before given, from a copy of this *Sarga* in a manuscript book. See 2d Report A. Tamil M.S. book. No. 20 section 5.

7. Notice of the *tirt'has,* or sacred pools. A *Brahman* sprung from the perspiration of *Gautama rishi,* at *Arnache'llam.* He became hierophant to the fane. Seven females were born from seven blades of *Darb'ha* grass, who became *danseuses* to the god. To the east of the fane is the *Indra*-pool. *Indra* bathed therein; by doing so removed his former defect; and obtained prosperity, co-existent with the sun and moon. To the south-east is the *Agni*-pool. If any one bathe therein at the full moon in *Panquni* (March-April) the doing so will remove the crime of infanticide. At the foot of the hill is the *Yama*-pool. If any one bathe therein the body will be healed of disease, and a golden coloured form acquired. Also at the foot of the hill is the *Nairiti*-pool; all sins are removed by bathing therein. On the west of the hill is the *Varuna*-pool. By bathing in it, the advantages bestowed by the nine planets are acquired. Beyond is the *Vayvu*-pool; by bathing in it all sorrows depart. On the north side is the *Cuvéra*-pool; by bathing in which poverty is removed, and wealth acquired. Near to it, towards the east, is the pool formed by the two *Asvinis.* If any one bathe in

* The *asuras* of this class had faces like buffaloes.

it, he will approach the feet of *Paramèsvarer* (or obtain beatification) after death. To the east of the before mentioned *Yama*-pool is the pool of *Agastya.* Those who bathe in it will acquire *Sarasvati* and *Lacshmi* (intellectual skill and outward abundance). There is also the pool of *Vasishta.* If any one bathe therein in *Arpisi* month (September-October) he will acquire all the learning of the age. There are besides, says the *Purana*, many other *tirt'has*, the merits of which cannot be told. To the north of the hill is a river, *Nri nadi*, the effect of bathing in which is to cause *Lacshmi* to dwell with *Vishnu* (or to produce order and plenty). Other rivers are mentioned, which remove crimes. Besides there is the *Punya*-river *(vulgó Pouniar).* A certain king bathed in it, and changed an effeminate to a masculine form. The *Cheyàr* derives its name from a weapon of *Subrahmanya*, the *vél*, which he dropped into it, and recalled. There is within the fane of *Trinomali*, the pool of *Siva.* If any one daily think on it, all kinds of crime will be removed. To the east of it is the *Chacra* reservoir. During the *Varàha-avataram Maha Vishnu* bathed therein, and by doing so acquired all the glory connected with the high office of *Vishnu.* All who bathe in it will obtain health. Finally there is the pool of *Brahma.* By bathing therein, all the evils that float in the sea of this life will be removed, and eternal happiness acquired. If any one on its bank give a bit of gold, however small, he will acquire possession of all that is enclosed within the seven seas surrounding the world. If a cow be so given, the merit of the gift is beyond the power of words to describe. If any one so give a white cow, such a one will ascend to *Cailasa*, on a white (or silver) vehicle, and be praised by all the residents there. If any one give a marriage dower on its bank, such a one will visit the *Satya-loca* (world of *Brahma)* ; and afterwards permanently obtain to the paradise of *Siva.* If any one give a donation of land, the reward is too great to be described. If any persons cause a pond, or well, to be dug at *Arnàchellam*, they will acquire the prosperity of *Indra.* Further, on the place of sacrifice there being a little dust, a crow flying by swept off the said dust by the concussion of air from its wings, and *Siva*, in return for the unintentional service, gave the crow beatification. Besides a large kind of rat (bandicoot), from delving in the ground, cast up a jewel *(mànicyam)* before the shrine; and the god, saying it had supplied him with a light, gave a gracious reward. A spider spinning a web in the shrine, the god was rejoiced in being supplied with a garment, and caused the spider in the first place to be born a king, and afterwards to be beatified. Such, says *Suta* to the *rishis*, is the glory of the fane of *Arnachellum.*

8. This section specifies the rewards consequent to walking round the hill, and to bathing on certain days of the week. For example, to walk three steps when circumgyrating the hill is equal in merit to the performance of an *asvamed'ha* sacrifice. To bathe on Sunday, secures the bliss of *Paramesvarer ;* on Monday, secures not only equal power to that of *Indra* over the seven worlds, but also a form like that of *Siva ;* on Tuesday, removes poverty, secures wealth here, and beatitude hereafter ; on Wednesday will give the power of acquiring all magical knowledge and secures beatification ; on Thursday will give the privilege of becoming *guru,* or spiritual preceptor, to the *Trimurti* or *Hindu Triad ;* on Friday will secure the beatification of *Vishnu's* world ; on Saturday will secure perfect happiness, and is equal to the merit of bathing on the night of *Siva,* at the new-year, and in the months of *Arpisi, Carticeya* and *Margali* (or October, November and December). The contents of this section were narrated by *Brahma* to *Sanaca,* the great sage.

9. *Brahma* to *Sanaca* in continuation, declares the extreme penalties incurred by those who presume to say any thing against the shrine of *Arnachellam,* involving death, seizure by *Yama's* messengers and severe punishment in *Naraca,* or the lowest hell. *Brahma* continues stating that the thousand-rayed sun, coming rudely with his horses and chariot, to the point, or peak, of the hill, was reproved by him *(Brahma)* and told to go and pay obeisance to the lord of the shrine. The sun paid homage, which was accepted, and he now uniformly passes to the left (north) side of the hill.

10. The legend of *Pradiiya-raja.* *Brahma* tells *Sanaca* the extreme punishment incurred by those who presume to steal any thing from the shrine of *Arnachellam,* being seizure by *Yama's* agents, and consequences, as in the last section. An example is given in the case of *Pradatya-raja,* who came from the north,and coveted a part of the possessions of the fane, for which his face was turned into that of a baboon, and on seeking pardon for the fault, his proper countenance was restored ; by consequence no one can with impunity covet the possessions of this shrine.—See a fuller abstract of the contents of this section 2d Report Tamil MS. book No. 20. section 4.

11. This section relates to the removal of crimes. *Brahma* tells *Sanaca* that the eight *Vasus* (or leaders of celestial hosts) becoming vain and proud of the merit of their penances, and performances, boasted of the same in the presence of *Agastyar,* who denounced on them loss and degradation. To recover their former situation they were directed to go and do homage at *Arnachellam.* Accordingly the eight *Vasus* did homage, at the eight points of the compass, and were restored. Other crimes

among celestials are specified, as removed at this shrine. Among them *Chandra* (or the moon) committed a fault in reference to *Rohini* and was punished by *Dacsha*, but the punishment was removed by paying homage here.

12. This section relates to *Pulacatipa*, an *asura*, who provided the perfume of civet for the shrine, and acquired great merit for so doing. Since then civet-cats are kept, and the reward of offering that perfume is very great. A recapitulation of the transit of the contents of the *Purana*, down to its latest delivery to the *rishis*, with the mention of which the book ends.

Note.—The MS. No. 27 is complete. It is old and somewhat damaged by insects. The MS. No. 18 is fresher in appearance; but also a little damaged. The damaged leaves in this copy I have had restored by the aid of both copies, and one being complete may suffice. Both MSS. are in verse with a prose explanation. They are entered in Des. Catal. vol. 1, p. 168 art. xvii.

Remark.—If the reader shall have perused the foregoing abstract, it will be only necessary further to observe, that in *Saiva* fanes of the Peninsula, the local *Purânam*, and not the *Vedas* gives the religion of the votaries.

14. *Dandi Alancaram*, or the rhetoric of *Dandi*, No. 63—Countermark 220.

In this book there are two copies tied up together. The first copy contains the *mulam*, or original poetical stanzas of *Dandi*, together with exemplifications or examples, and is complete. The second copy contains the original *sutras* together with the *urai* or commentary, in verse, by some other unknown author; added to which are the exemplifications. This last copy wants a few leaves at the end of the commentary. The book is a little injured in one or two places, by insects; but not seriously. The work is not scarce.

Dandi next to *Calidasa*, is said to have been the most celebrated poet at the court of *Bhoja-raja*. He has the traditionary reputation, in the Peninsula, of having been *Ubaya-cavi*, or a poet in two languages, the Sanscrit, and the Tamil. The above work is on thirty-five kinds of poetical, or rhetorical, ornament; and, with reference to the Tamil art of poetry, the work is considered to be valuable.

This book is briefly entered in Des. Cat. vol. i. p. 252, art. vi.

15. *Jataca Kerala alancaram,* a treatise on astrology No. 69—Countermark 233.

This manuscript is a poem of one-hundred palm-leaves; probably written according to the notions of astrological science prevailing in the *Keraladesam,* or *Malayalam* country. It has a great variety of details on different circumstances, occurring in the course of life; respecting which mankind have usually been found to have an anxious eye directed towards the future. A full detail, as to native ideas on astrology, is quite requisite to a knowledge of their manners, or motives, or guiding principles.

Astrology is inseparable from their mythology, and both, to an amazing degree, influence the conduct of a *Hindu.* Both tie him fast under Brahmanical ascendancy. An exposition of *Hindu* astrology, by a verbal translation of recognized systems, seems to me desirable. It would be a more than usually difficult work, and might require the undivided attention of some one individual, for some length of time. Without a knowledge of the *local* mythology, and the received astrology of any portion of our *Hindu* fellow subjects and fellow men, it seems to me that legislators, and religious teachers, must equally labour in uncertain twilight, without a clear discernment of the subject on which they operate.

Note.—The book is entered in the Des. Cat. vol. i. p. 255, art. vi.

16. *Navya-sastra,* or the art of building and navigating vessels, No. 78—Countermark 259.

Some directions are given respecting the materials, and dimensions, of vessels. But the work is chiefly astrological; in matters relating to prognostications concerning navigation. At the close there is a leaf or two on the *raja-yogam :* children born under that astrological sign will acquire very great success, and prosperity.

Remark.—Seven leaves of this tract were recovered from MS. No. 97, and being added to the beginning of this document render it now complete. It is also in tolerably good order, and written in a very legible hand. It seems to be a work of somewhat ancient composition.

The *Sutras* are without commentary.

It is entered in Des. Cat. vol. i. p. 261, art. ii.

17. *Rangha Calampacam,* or incense to *Vishnu,* No. 144—Countermark 167.

18. The same (duplicate) No. 145—Countermark 202.

This is a poem of one-hundred stanzas, in praise of *Rangha,* a name of *Vishnu* at *Sri-rangham* and other places. The word which I have rendered "incense" signifies more properly a mixture of odoriferous perfumes, of which I need not extract the quintessence. It is also a technical name of one class of Tamil *Prabandhas,* as containing a mixture of various poetical measures. The first manuscript is perfect and uninjured, the second copy is somewhat damaged by insects, and will require to be looked at occasionally, though its restoration is not immediately urgent: it is otherwise complete.

One copy is entered in the Des. Cat. vol. i. p. 225, art. xxxix; but without any mention of a duplicate; both MSS. bear the usual marks.

19. *Siva-vacya-padal,* or the chant by *Siva-vacyar,* No. 132—Countermark 132.

This is a didactic moral poem, characterized chiefly by its monotheistical purport. It is very severe on idol worship, and on various abuses connected with the common *Brahmanical* system: maintaining the necessity of rejecting the names of *Siva* and *Vishnu,* and worshipping one only god. Hence it has always been made great use of by native Christians in disputing with *Hindu* natives. I was told some years ago that the *ascetics* (or *Pandarams*) of the *Saiva* class, seek after copies of this poem with avidity, and uniformly destroy every copy they find. It is by consequence rather scarce; and chiefly preserved by native Christians.

This copy is complete, as to the No. of palm-leaves, but very much injured by insects. Collating it with a copy heretofore belonging to the late Dr. Rottler, now in my possession, I have had one good copy carefully restored.

Note.—It is entered in Des Cat. vol. i. p. 225, art. xxxvii, as containing "stanzas in praise of *Siva* as the only supreme or *Paremesvara.*"

20. *Naladi-pada-urai*, No. 99—Countermark 208.

21. The same work, No. 100—Countermark 209.

These two manuscripts are copies of a moral work, the contents of which relate to the duties proper to various ages of life, particularly those of penance and alms-giving, on which latter subject there is much said, and much on the use, and abuse, of riches. Certain evils and crimes, are denounced as leading to future punishment in *Naraca.* The work is of superior composition in quatrains; and as each line is termed in Tamil poetry a foot, hence seemingly came the title of *Naladiyar*, by which it is popularly, and respectfully, denoted that is "the respectable four lined one."

It is ascribed as regards authorship to the *Samanar* (*Bauddhists*, or *Jainas*). and had the rare merit of being spared by the bigotted *Brahmans*, when they destroyed all other books of their opponents, by casting them into the *Vaigai* river at Madura; after the triumph of the *Saivas* in the reign of *Kuna Pandiyan.* The story is that, whereas all the other books went down with the stream, this one ascended *four feet* against the stream, by reason of which wonder it was taken out and preserved. This tale is however merely symbolical. A better reason may be its being free from sectarian peculiarities, and available to the advantage of *Brahmanism.* In the same manner the *Cural* passed the *Brahman*-ordeal, for a similar reason; but not without a symbolical tale being invented to give a colour of reason, and to render the acceptance of a *Pariar's* work pardonable.

Remark.—As a moral didactic work esteemed to possess high merit, invested with the sanction of the Madura college and being of high popular repute, a good translation of the *Naladi-pada-urai*, well edited, would be an acquisition; and I am happy to learn that such a version is in progress in able hands. The poem does not easily admit of being abstracted except in a brief indication. The two copies are complete, and in tolerably good preservation. The first of the two is the most recently written. They are entered in the Des. Cat. vol. i. p. 246, art. lxxii.

22. *Ulaga-niti*, a treatise on morals, No. 186—Countermark 191.

This is a very concise little book, chiefly consisting of brief prohibitions against vices or evils; with a few at the close declarative or hortatory. It is a school-book for children: but in the higher dialect. The authorship is ascribed to *Ulaga-nat'ha*; who, though his name signifies "lord of the world," was a man of the barber tribe. The title may be rendered either "worldly rectitude", or *Ulaga's Treatise* on Morals. The latter I suppose to be the right rendering.

Note.—The manuscript is fresh, and in good condition. It is entered in the Des. Cat. vol. i. p. 231, art. lx.

23. *Adi Chudi Venpa*, No. 174—Countermark 204.

24. Another copy, No. 175—Countermark 205.

These are two copies of a didactically sententious and moral work, used in schools, ascribed to *Avvai* or *Avvaiyar*; a sister of *Tiruvalluvar*, author of the *Cural*. Her name, like his, is merely titular: what may have been the proper name of either is uncertain. This work was entitled by the authoress *Niti-chol*, "a word on morals," or as it may be rendered, "a discourse on rectitude;" but some later writer prefixed stanzas of invocation addressed to *Siva*, or *Ganesa*, using the words *àdi-chúdi*, at the beginning of his panegyric, whence the book has improperly acquired its popular title. The alphabetical order is followed, beginning each line or sentence at first with the vowels, and then with the consonants, and syllabic letters. Hence the two-fold object is subserved of fixing the alphabetical order in memory, and of ingrafting, upon the whole, useful precepts. A translation by Dr. John, of Tranquebar, was inserted in the Asiatic Researches. When the book is used in Christian schools, the spurious prefix of praise to false deities is rejected.

Note.—No. 175 is complete, and makes rather a large book, owing to very little being written on each leaf. It is injured by insects. No. 174 in addition to the *Niti-chol*, in a compressed form, has prefixed the *Tandaliyar-satacam*, a poem containing praise addressed to *Siva*. There are 86 stanzas out of the 100, which form a complete poem of this kind; and appended are some loose leaves seemingly belonging to another book, containing portions of a *Tevaram*, and *Manica-vasacar-padal*; both *Saiva* works of hymnology. This copy is in good preservation.

Both copies are entered in the Des. Catal. vol. 1. p. 245. Art. lxix.

25. *Cónri-ventan*, No. 170—Countermark 170.

This is another school-book, by the same authoress, following also the alphabetical order; but with sententious maxims a little longer, and a little more difficult: adapted to a child that has gone through the former one. This book was also called *Niti-chol*; but acquired the common term as above, from a modern and spurious invocation to *Ganesa*. A translation of it by Dr. John was printed in the Asiatic Researches.

Note.—The copy is complete in six small palm-leaves, written in a rude and school boy's hand: by consequence the measure of wisdom which it contains is concentrated.

It is entered in the Des. Catal. vol. 1. p. 245. Art. lxx.

26 *Cummi-pattu* a poem, No. 203—Countermark 158.

This is a fragment only of a work by *Vedanayak* of Tanjore, a Christian poet of considerable attainments, and eminence. He made extensive use of Scriptural subjects, put into a poetical form, which he was accustomed to recite in the public places at Tanjore, after the manner of native minstrels; *Homeric* also, if we may credit tradition. This work he addressed to his daughter, as "wise" or "well taught", ending his lines with that phrase, as many natives do with the sort of expletive *ammáné*, when addressed to some goddess, or lady of quality. In this poem there are severe strictures on idolatry, and idolatrous customs; with cautionary prohibitions against assimilation to them. From the beginning forwards there are 21 closely written palm-leaves; but much afterwards is wanting.

Note.—It is entered in Des. Catal. vol. 1. p. 224. Art. xxxiii, but so as to lead to the inference of its being an ethical production, mixed up with astrology.

27. *Deva-rayen-pala-padal* No. 190—Countermark 175.

28. same title, No. 157—Countermark 176.

These two manuscripts seem to be parts of two copies of the same composition; purporting, according to the title, to be various chants by *Deva-rayen*. Neither copy is complete, and in each one there is transposition, and confusion. The copy of one must have been made by a

Roman Catholic Christian, indicated by an expression at the beginning; and there is one *viruthum* or stanza, which declares the unity of the Supreme Being, and the vanity of idols, in such a manner, as evidently to be the composition of a Christian. The remainder, in both copies, as far as complete, is a sort of centum of verses extracted from various authors, and without much coherence; so as to wear rather the appearance of such kind of poetical extracts as are sometimes made in an album. Both copies seem to me quite useless; and are allowed to remain as I found them. They are entered in the Des. Cat. vol. I. p. 226, art. xlvi, and are stated to contain "praises of *Vishnu* and *Siva*, and especially of the forms of the latter and his spouse worshipped at Madura, or *Sundaresvara* and *Minakshi-Ammal.*" This definition of the contents is very incorrect.

29. *Nannul Padaveyal,* Tamil etymology—No. 60—Countermark 211.

30. *Nannul*, a Tamil grammar—No. 61—Countermark 212.

The first of these manuscripts (or No. 60) is a part of the *Nannul*, being the chapter on etymology termed *padiveyal*, treating of words. It contains the original *sutras*, with the comment of *Sancara-Nama-sivaya* in *Shen*-Tamil, and another comment, or explanation of the comment, in *Codun*-Tamil, or the common dialect. This MS. is written on *Talipat* leaves (used in the extreme south); and is in good preservation.

The other M.S. (No. 61) is an imperfect copy of the same famous grammatical work by *Pavanandi*, abridged from the *Tolcapiyam*, as the latter is said to have been abridged from a still larger work of *Agastya.* The *Nannul* had three explanatory commentators; the comment in this MS. is that by *Sancara-Nama-sivaya Pulavan* alone. The MS. is however very deficient; at the beginning it wants the preface, the two first chapters, or sections, and a small part of the third at its commencement. Part of the 4th section, at the end, is wanting; and all the remainder, what there is of the contents is on orthography only. The leaves of the book are not of equal size; and seem like fragments of two books put together; being a fragment still. The leaves are of the broad kind common only in the extreme south of the peninsula. They are in tolerably good condition.

Note.—The two copies are entered in Des. Cat. vol. 1, p. 247, art. 2. —It will be seen from what precedes that if both MSS. were put together they would not form a complete copy of the entire work.

31. *Tonnul-vilacam*, a grammar of rhetoric, No. 62—Countermark 213.

This is a work of high reputation by *Viramamuni*, or *Beschi*, a Roman Catholic Missionary of the early part of the 17th century; whose philological works stand quite apart from those of any other European writer. He had many learned natives to assist him. He was, however, beyond all question, the most distinguished Tamil scholar of his age. This work is a grammar of the *Shen*-Tamil inclusive of prosody, tropes and rhetorical embellishments. It was translated by Mr. Babington of the Madras Civil Service; and is still a standard work for reference.

This copy wants five palm leaves, of the index only, at the beginning; the remainder is complete. The leaves and writing are quite fresh in their appearance: and remain undamaged.

Note.—It is entered in Des. Cat. vol. 1, p. 218, art. 3.

32. *Chitambara Agradi* No. 66—Countermark 224.

This manuscript is a vocabulary (termed *agradi* or *nigandu*) of the Tamil language, by *Revana Siddhar* of *Chillambram.* It is in *Sutras* or in brief verses, and does not extend the alphabetical order of arrangement beyond the first letter; under which order simply the words are arranged, and the meaning or meanings, given. It is a much more brief, and simple, composition, than the *Mandala purush-nigandu*; but better adapted for memory, or as a manual. The copy is complete, of recent hand-writing, and in good preservation.

It is briefly entered in Des. Cat. vol. 1, p. 252, art. viii.

33. *Hari-Vilakam* hymns to *Siva.*

34. *Agastya-nyanam*, the wisdom of *Agastya.*

These works were found tied up together with a few pages of the *Navya-sastra*, which last pages were discovered to be wanting in that manuscript itself, and being restored to the proper place completed it. Perhaps the whole originally formed one book; since, in size and appearance, they correspond.

The *Hari-vilakam* is mystical poetry, of a kind needing no special abstract.

Agastya-nyanam, is, I am persuaded, a literary forgery, the work of some *Uttra Saiva* devotee, ascribing his own composition to *Agastya*. In the work of creation the order of the *Trimurti* is *Siva*, *Brahma*, *Vishnu*; in the manner of the modern *Uttra Saivas* of the Peninsula. Very strong and pointed condemnation is given of the *Vedas*, as well as of the *Ramayana*, *Bharatam*, and in short all *Vaish-nava* books, or those that are consonant to the more universally received *Hindu* system. The writer professes to give an account of his own birth as being *Agastya*, and mentions some of his works. Some moral sentences are mingled up with the other matter. I am not sure that it is not a forgery of the days of Robert de Nobili under an *Uttra Saiva* veil; but, at all events the name of *Agastya* is a *nom de guerre*, to serve some special purpose. The *Hari-vilakam* is a little injured by insects, the rest of the book is in very good order, and complete.

See Des. Cat. vol. i. p. 228, art. liii.

35. *Sivapracasica*, a work on austerity, or self-control, No. 130. —Countermark 57.

This poem is of the kind treating of the *tatva* system or different parts, properties and regulation, both of the material, and immaterial, portions of the human body. The allegorical description of the body, as a city; having gates, and a resident within, or the soul, is contained herein. The same allegory is found in the *Bhagavatam*, ascribed to *Nareda*; and also in other distinct productions, of which the present is one. The body is divided into five elements, and five qualities of the mind are specified; to the varied union, or combination of which elements, certain operations, both corporeal and mental, are ascribed. Absolute renunciation of all earthly attachments, that to father or mother being included, is taught. Severe penance, and personal subjugation are enjoined. The worship of *Vishnu* is to be rejected; and the system of *Siva* alone ought to be observed. The work bears the name of the author *Sivapracasica* (one having the splendour of *Siva*), and the contents are sufficient to indicate his having been a *Pandaram* (or ascetic) of the *Saiva*-order. There is a monasterium of that class at Madura, another at *Mailapur*, and others in different places.

Note.—The MS. is complete, and only a little injured, at present

not sufficient to call for restoration ; but it will require to be occasionally looked at for better preservation.

It is entered in Des. Cat. vol. i. p. 231, art. lvii.

36. *Aruna-giri-nat-ha-tiru-pugerzh* or hymnology, No. 138—Countermark 203.

37. Same title, ——— No. 139—Countermark 179.

38. Same title, ——— No. 140—Countermark 66.

39. Same title, ——— No. 142—Countermark 1078.

No. 138 contains 106 stanzas, and is complete.

The MS is old, and the leaves are considerably damaged by insects. No. 139 contains 50 stanzas, and remains incomplete at the end. It is fresh and in good condition. No. 140, contains 55 stanzas, not finished : it is old, and damaged by the breaking of one or two leaves at the beginning, and at the end. (It is supposed from the Nos. that there should be another copy : but this has not been met with).

No. 142 contains 84 stanzas, wants the 33d and 40th leaves, and does not finish at the end. The palm-leaves are comparatively fresh ; but damaged by insects in several places.

These manuscripts are portions only of one great work ; reputed to contain in all sixteen thousand stanzas, of the kind termed *Viruttam* by *Aruna-giri-nat-ha*, so called after the god at *Trinomali*. His name forms parts of the above title, and the words *tiru-pugerzh* mean sacred panegyric. This panegyric is contained in a series of hymnology ; addressed to a form of *Subrahmanya*, worshipped at *Tirtani*, near Madras.

Note.—The title appears in Des. Cat. vol. i. p. 225, art. xxxviii ; but only one copy seems to be therein entered.

40. *Tiruvachacam Hymnology* by *Manica Vasacar*, No. 103—Countermark 161.

41. Same title ——— No. 104—Countermark 162.

42. Ibid. ——— No. 105—Countermark 163.

43. Ibid. ——— No. 106—Countermark wanting.

These are copies of a collection of panegyrical stanzas by *Manicavasacar* whose story is narrated in the *Vadur*, and Madura *St'halapuranas*. After relinquishing his office of minister of state to the Madura king, and undergoing severe treatment, as narrated in those legends, he became a devotee of *Siva*: and, exclusive of disputing with the *Bauddhists*, he wandered about in the manner of ascetic minstrels, such as *Appar*, *Sundarar* and others, and composed brief panegyrics of different forms, or emblems, of *Siva*, worshipped at different places. The entire amount of such chants was fifty-one; which chants (consisting at least of 10 stanzas, but generally one, two, or three more) make up a total of six hundred and sixty stanzas of the kind termed *viruttam*, with a few of the plainer kind termed *agaval*. For a further account of the work see abstract of the *Vadur St'halapuranam.*

No. 103 is complete. There are added 27 chants from the *Tevaram*, a similar collection by *Appar*, *Sundarar*, and *Sampantar*. The whole forms a small sized pocket volume, which, though rather old, is quite uninjured.

No. 104 is complete. It also contains a portion of the *Tevaram*, not complete. This small book is old, but nevertheless in good preservation; save only a little wear at the edges.

No. 105. This copy wants seven chants, in different places. Forty eight stanzas are appended of a polemic poem against the *Bauddhas*, not complete. This manuscript is fresh, slightly punctured by insects, but to a trivial degree.

No. 106 has 38 chants wanting. It has two appendages, being fragments of poems of the *Venpa* kind, without title; but containing praises of *Siva.*

These four copies are entered, with a brief mention of contents, in the Des. Catal. vol 1. p. 224. Art. xxxv.

44. *Vriddhachala Puranam*, No. 21—Countermark 30.

This copy is in verse only, and is complete. It is generally in good order; but with an exception of five leaves in the middle, which have been restored, in order to preserve the manuscript legible and entire.

45. Same title, No. 22—Countermark 31.

This copy contains the original verse, with a prose explanation. It is in good preservation: except four leaves, near the middle, which have been restored. It is now complete; having had two sections, before wanting, added to it from the next copy.

Same title, No. 23—Countermark 32.

This copy is in verse, and prose; but is very incomplete; wanting five *sargas*, or sections, from No. 14 to 18 inclusive. What remains is without defect; and, being apparently of recent writing, it is in perfectly good preservation. It enabled me to complete the preceding copy.

Another book, having the same title on the envelope, was found to be a copy of the *Vadur St'hala-puránam*. Five copies of the *Vriddhachala-puranam* are mentioned in the Des. Catalogue. The fifth is not now in the collection.

The following is an abstract of the contents.

1. The prefatory section. Invocations to deities, and to *Appar*, *Sundarar*, and other *Saiva* poets. It is given as narrated by *Suta-rishi*, who received it from *Sveta-muni*; he from *Vyasi*; the latter from *Subrahmanya*, who heard *Siva* relate it to *Uma*.

2. The *giri-sarga*, or section concerning the hill, narrated by *Aran* or *Siva* to *Uma*. Though the legend is unknown to *Brahma*, or *Vishnu*, yet there is a propriety in relating it to *Uma* though young, from her being mountain born. The pre-eminence of the hill, above all other hills, is asserted: so that even thinking of it will remove evil, produce good, and lead to beatification; which, by means of this hill, even the most stupid of people may acquire. Its excellence arises from its being a copy of the form of *Siva*.

3. Concerning the place; narrated by *Natha-sauma-muni* to his wife, named *Anavati*. It relates to a sacred pool for bathing named *Tiru-amrita-kunram*, formed by the *Mutta-nadi* river. Bathing therein accompanied with certain observances removes the crimes of ingratitude, theft, drinking ardent spirits, killing cows, or *Brahmans*, coveting the wife of a *Brahman*, or a neighbour. If dogs, jackals, or such like animals, die at this place they will attain to *Siva's* world; being taught instruction, while dandled in his lap. The ills, or crimes, done by children will be pardoned even as those of grown up people. The names of the seven great *rishis* are mentioned, who obtained gifts, according to their desire at this place.

4. This section relates to the high value and excellence of the *Muttà-*

nadi river. The merit of bathing in it is related. For example, if it be only seen, by the favour of the god, sin will be removed. To bathe in it is equal to the merit of an *asvamedha* sacrifice, and to remain in it during one bright half of the natural day ensures beatification. *Agastya* and several others by bathing therein, acquired sanctity.

5. *Isa* enquires of *Uma* concerning the shrine. A special eclipse is adverted to, at which time the *vimana* appeared, with various marvellous accompaniments. The benefits of worshipping thereat are narrated.

6. The section of *Viba-chittu*. One of *Cuvera's* precious jewels, was picked up by a particular kind of bird (mistaking it for its food) and carried to the top of a tree ; when the bird dropped it on the head of a person named *Viba-chittu*, doing penance. He did not know what to do with it; and, while wandering about on the mountain, an aerial voice directed him to deposit the gem in a *vanni*-tree, and then to go and receive instruction from *Romasa rishi*. He did so, and the *rishi*, by his merit formed a *Calpa-vricsha*, or tree of plenty ; yielding every thing desired. In consequence *Viba-chittu* had a golden image made for the shrine with all other needful appurtenances : and ultimately " attained the feet of the god," or was beatified.

7. The *tiru-náda* section, narrated by *Brahma*, and downward through various celestials. It relates to a particular locality, on the hill where birds are fed termed *tiru-amrita kunram* ; where also *Siva* condescended personally to make an appearance, and to receive adoration.

8. The section of *Agastya*. This relates to *Agastya's* journey to the south ; being resisted by the *Vindhya* mountain, he trampled on and lowered it ; he afterwards met with *Váthan* and *Vil-vathan* who were accustomed to kill and eat travellers when passing by : he denounced his anger on them and destroyed them. He then proceeded to *Vriddhachala*, where he bathed ; and, seeking pardon, for having killed the said cannibals, *Siva* appeared, granted his request, and then vanished.

9. The *Calinga* section. A *Calinga* king, did not pay proper respect to *Romaca maha rishi*, but mocked him ; in consequence of which the *rishi* denounced on him the doom of becoming an evil-spirit-possessed wanderer. He embraced the sage's feet, demanding when and where, the crime would be expiated, and was told it would be at *Vriddhachala*. He accordingly became possessed with an ill-spirit, and roaming about, came to *Vriddhachala*, where bathing in the *Mutta-nadi* he was relieved. As a moral, a caution is added not to mock sages, who are performing penance.

10. The section on removing the evils of the *Cali-yuga*. The sages enquired of *Suta-rishi*, the magnificence of the lord of *Vriddhachalam*, and he answered by saying that *Sanat-cumara*, and others, went to *Brahma* on *Maha-meru*, who enquired the reason of their sadness. In reply a pathetic detail was given of the poverty, and other evils of the *Cali-yuga*; in which the kings were *Sudras*, the sacred beads indiscriminately worn by all, and many other ills; on which a petition was founded that *Brahma* would form a shrine to remove them all. The request was answered by the means of the shrine at *Tiru-amrita-kunram*, which removes or sets aside all the evils of the degenerate age.

11. The *Sweta* section. *Sweta* was a king of the *Curu* race, who ruled over many persons with the integrity of a *Chacraverti*, till losing his wife by death, he became desirous to renounce the world, and to acquire as quickly as possible instruction as to the means of obtaining final happiness. In pursuit of his object, he went on pilgrimage, and among other places to the shrine of *Jambukesvara* at *Tiruvanica*. In an interview with *Agastya*, the latter stated the advantage he had acquired by doing homage at *Vriddhachala*; and recommended his pursuing the same course; which advice he followed; and, in consequence *Siva* appeared to him, and bestowed on him the gift, and happiness, which he desired.

12. The section of devout worshippers. The benefit of affectionate worship is illustrated by reference to a *Chetti* who had four sons; three of whom were liberal and charitable, and were beatified, at other fanes specified; the fourth was of a vicious disposition, and conduct, in consequence of which, and of his slighting the *Brahmans*, he brought on himself the visitation of *Brahma-hatti*. When suffering under this infliction he met with a *Brahman*, and asked how his disorder could be removed, who directed him to be liberal in donations to the shrine at *Vriddhachala*. He accordingly became extremely munificent, in providing butter-oil for the anointing of the image, and for lights, and in gifts to the *Brahmans* and servants of the fane. By persevering in this course, in the space of a year, he was entirely relieved of his disorder, and obtained consolation. The benefit of devout homage at this shrine is hereby apparent.

13. The *Siva-puja* section. *Siva* replies to *Uma's* enquiries. This section relates to various symbols of *Siva*, and to plants, and herbs, used in the ritual ceremonies of *Siva's* worship.

14. The *Vibuthi*-section. Declared by *Siva*, to the four orders of *Sanniyasi*, *Vanaprast'ha*, *Brahmachari* and *Grihast'ha*. It relates to the formation, and use, of the sacred ashes used by *Saivas*, and the parts

of the body to which the same ought to be applied. This being done the very person of god (*sacshat-kadaord*) resides in the wearer. Any *Chandalas* who ridicule the use of these ashes will go to *Naraca*. The eulogy of the *Saiva* worship is added.

15. The *rudracsha* section, narrated by *Nat'ha Sauma* to *Anavati*. The different varieties of beads termed *rudracsha* are specified, as appropriately belonging to the *brahmanical*, kingly, mercantile, and servile, classes; and the advantage of wearing them is declared. (Perhaps the origin of their use may have been a simple device to distinguish the different classes, or orders, of men).

16. The *Kirti* section. The same person relates, to the same individual, the fame of this place; stating that though beatification is of difficult attainment, generally speaking in the *Cali-yuga*, yet that it may be easily attained at *Vriddhachala*. If any one at this place, repeat the name of *Siva* three times, at the mention of the first *Siva* will appear, and give what is wanted; at the mention of the second, there will be a surplus of merit; and the third will secure his residence within the worshipper. Hence even the thousand tongues of *Adi-seshan* could not tell all the excellence, and fame, of this place.

17. The section of the bullock mountain, narrated by the same to the same. *Parviti* performed homage to a particular image, until *Siva* appeared, and asked what gift she desired; to which the reply was, that she wished a shrine to be formed at the same locality, to be called after *Nandi*, his bullock vehicle, and the request was conceded. At this place *Vishnu*, *Brahma*, and the celestials did homage, and obtained gifts. Many *rishis* did the same.

18. The section of *Sashi-vanna*. *Siva* declares to *Vishnu*, the excellence of his (*Siva's*) votaries. *Sashi-vanna* was the son of a *Brahman*, but one who despised *Siva*, the *Vedas*, the *Brahmans*, and true equity. At the same time he lived a bad life; so that many of his family went to *Naraca*, and he became a *Chandala*, afflicted with leprosy. In consequence he performed penance; and enquiring how to get his disease removed, he was directed to the above mentioned bullock-mountain-shrine, whither he proceeded; became entirely cured; and obtained beatification, both for himself, and for his relatives, who before had gone to *Naraca*. Hence the efficacy of that shrine is deduced, by way of inference.

It is added, in conclusion, that whosoever reads, hears, or copies out this *Saiva-puranam* will obtain happiness, learning and beatification.

The end of the *Vriddhachala-puranam*.

Note.—To any who has read through the preceding abstract it will be

superfluous for me to suggest any remarks. The locality of *Vriddha-chala* (old-hill) I understand to be intermediate between *Trinomali* and the *Caveri*-river, that is to Verdachellum in the Carnatic.

The MS. is entered in Des. Cat. vol. 1, p. 169, art. xviii.

47. *Vadur St'hala-puranam,* No. 19—Countermark 28.

48. Another copy, No. 36—Countermark 81.

49. Ibid. No. 37—Countermark 82.

50. Ibid. No. 38—Countermark 83.

The first of these copies was erroneously labelled as a copy of the *Vriddhachala-puranam*. It is a very defective manuscript, wanting four *sargas*, out of the eight, of which the work properly consists. Of the remaining four sections the deficiencies are 95 stanzas from the cooly section, 70 stanzas from the fane-section, and 99 from the *Baud-dha*-section, only one section is complete. The composition is in verse, with a prose explanation or commentary. [There remains 126 palm-leaves a little old in appearance; but quite uninjured as to condition.

No. 36 is apparently quite a recent copy: it is also complete in 289 palm-leaves, containing 525 stanzas; each stanza being accompanied with a prose explanation.

No. 37 has a deficiency of 10 stanzas in the 2d section, 1 stanza in the 3d section, 4 stanzas in the 7th section, and 1 stanza in the 8th section, being 16 stanzas in all, leaving the remainder complete, untouched by insects, and in perfect preservation.

No. 38 has a deficiency of 20 stanzas in the section about the horses: the remainder is complete. The copy is old; but, with a few slight exceptions in very good preservation.

No. 39 being complete, nothing needs to be done, as to restoring the remaining copies. The following is an abstract of the contents:

1. The usual invocation, and eulogistic stanzas.

2. The *mantri* section. It narrates the parentage and education of *Mànica-vàsacar*, at *Vadur*, in the *Pándiya* kingdom. He was a *Brahman;* and received the sacerdotal string at 14 years of age. Being of

superior intellectual qualifications he was chosen by the *Pándiyan* king as *mantri*, or minister of state; in which capacity he conducted the affairs of the kingdom with great equity. He received 40 crores (of money) from the king with an order to purchase horses; and on his journey, with that object in view, at *Tiru-perunturai* was fascinated by the god, *Siva* as *Jangama-svami*, chanting mystic songs. He went near with his whole retinue, and listened with great delight.

3. The *Tiru-perunturai* section. So far *Manica-vasacar*, was merely a hearer at a distance; but he was now brought specially into the presence of the god, and was introduced to the said *Siva*, seated on a throne. *Siva* condescended to teach him the mystic sense of the *agamas*, and various *Saiva formula;* in consequence of which his eye of ignorance departed, and he was spiritually illumined. When fully taught, the god asked what present (as customary) he intended to pay as the price of his initiation to disciple-ship; when he laid the whole 40 crores, received as above, as an offering at the feet of the god, who was greatly rejoiced. While *Manica-vasacar* was thus engaged, his attendants wondered what was become of him; and seeking him out, reminded him of the king's business, and the need of attending to it. He was absorbed in contemplation, and paid no attention to them: on their becoming more urgent, he opened his eyes, asked them who they were, and who was the *Pandiyan* king of whom they spoke; adding that they did not appear to him to be votaries of *Siva*, and told them to depart. They accordingly went, and reported the matter, to the king; who, being much incensed, wrote a severe letter and sent it to his lethargic minister. The latter, on receiving it, appealed to the god; who directed him to send word, that on such a day of such a month, horses would come. The king enquired if there was any appearance of horses at *Perunturai;* and being answered in the negative, he sent peons, with directions to seize and bring the minister to him; which was done. *Manica-vasacar* was put in irons, and cast into prison for several days; treatment which he endured with composure; and occupied himself in chanting the praises of *Siva*.

4. Horses-section. According to the word which *Siva* had directed to be sent, the said god, assembled all the jackals throughout the country, and turning them into horses, caused the celestials, under human forms, to mount them as riders, while he himself assumed the form of the king of *Ariya-desam*,* whence the horses were expected to be procured; and, on the day appointed, the whole cavalcade came to the town of the *Pandiyan* king. The latter was extremely well satisfi-

* Part of Travancore.

ed; had the qualities of the horses examined; and, finding them to be superior, appointed their location. While at the same time he released his minister from durance vile, who went to his house, and sang the praises of *Siva.* During the night by the power of *Chocapa* (the form of *Siva* at Madura) the horses re-assumed their natural forms as jackals; and greatly disturbed the whole town. The king, doubly incensed, and greatly disappointed, commanded the seizure of *Manica-vasacar,* and his being put to a certain species of torture in the dry bed of the *Vaigai* river. This torture consisted in his being stretched out on the sand with a heavy black stone on his body, to keep him down; suffering from the burning sun, and scorching sand, by day, and cold by night; until the 40 crores should be re-imbursed. *Manica-vasacar* endured with fortitude, invoking the aid of *Siva.*

5. The Cooly-section. The god knowing the sufferings of his votary directed *Ganga Bhavani,* to go down to earth, and relieve his distress. Accordingly *Ganga Bhavani* came down; and, filling the channel of the *Vaigai,* caused an inundation extending even to the walls of the fane. The king directed the customary offerings to be paid to *Ganga*; but, on throwing these into the water, the inundation swelled still higher, threatening destruction to the whole town. The king was at a loss as to what want of equity, on his part, was the cause; but directed repairs of the damages, and of the banks of the river. Every person in the town had an allotted portion of work to do. A poor widow who had no son, and lived by making and selling balls of rice-flour, represented, to the god in the fane, her inability to do her own portion of work. Soon after the god himself came with the appearance, and usual implements of a cooly, crying out for work; and was engaged by the widow as her cooly. On his enquiring about wages, she replied that she could only pay in the commodity by the making and selling of which she gained her subsistence. He took a portion in advance; and on being shewn by the widow her share of work, threw carelessly half a large hoe-full of earth into his basket: and then, dancing about as he proceeded, the widow suspected a bad bargain; but he told her to go home, and he would finish the work. Instead of doing so he laid down to repose under a tree. The king, coming to inspect the progress of the repairs, found the widow's portion neglected, and was pointed to her cooly asleep under a tree. Arousing the sleeper, the king prepared to give him a blow with a rattan; seeing which the god protected his left side, and received the blow on the right; a blow which was felt by the whole creation. *Manica-vasacar* startled at receiving a blow on the side, enquired into the circumstance, and discovered it to be an amusement of *Siva,* who had

disappeared. *Manica-vasacar* went to *Peruntara*, and, at his request, the god appeared; taught both him and the king some lessons; and directed that *Manica-vasacar* should be employed in disputing with the *Bauddhas*.

6. The fane-section. *Manica-vasacar*, again at *Perun-turaiyur*, represented all his sufferings to the god, and received various instructions from *Siva*. The god then assembled all his votaries, and told them that he was about to return to *Cailasa*, that after his doing so, a fire would appear, into which all his followers, with the sole exception of *Manica-vasacar*, were to cast themselves; and on their doing so, their beatification would be assured. On the departure of *Siva* according to the preceding declaration, *Manica-vasacar* fell on the ground, on the spot where the god had been, and wept greatly. Soon after a large fire appeared, into which the *Saiva* votaries cast themselves, as they had been told to do. *Manica-vasacar* left the place, and set out on pilgrimage to the various *Saiva*-shrines in the southern part of the peninsula, such as Conjeveram and others; at each of which shrines he composed, and chanted, hymns in praise of its local *numen* (the assemblage now forming the *Tiruvachacam*). He subsequently returned to the neighbourhood of *Chillambram*; where he constructed for himself a hut, or sort of nest, in a tree. Here he continued rendering homage to *Siva*.

7. The *Bauddha*-section. *Manica-vasacar* had studied, and was deeply versed in the *Tatva* system (relative to the corporeal and mental qualities of human nature, their relations, union, and consequences); and being now disposed to visit *Irza-desam* (Ceylon) he proceeded thither, and every where proclaimed the name of *Siva*, under a particular title, by which he is known at *Chillambram*. In consequence of hearing so much about this name, the king sent for *Munica-vasacar* and desired to know what it meant; when it was explained to mean the musical sounds proceeding from the shrine of *Siva* at *Chillambram*. The king of *Irza-desam*, in consequence announced his intention of sending a colony of his own people, with sacerdotal attendants, to that place, to construct there a shrine of the god worshipped by himself, that is, *Buddha*. The colony was accordingly sent, and the fane built. But the three thousand votaries of *Siva* dwelling in the *Tilli* wilderness, became alarmed at this innovation; and going to the new settlers, told them to depart. As they refused to do so, information on the subject was sent to the *Chola* king of the country. Ultimately both the king of *Irza-nad*, and the *Chola* king, came to *Chillambram*; when it was agreed on to hold a public disputation. In the interim, the god

appeared to his votaries; and told them not to engage in the discussion, since they would not be able to compete with their opponents; but instructed them to trust the entire management of the question to *Manica-vasacar*. In consequence *Manica-vasacar*, was put in the seat of honour, and the *Bauddhas* directed the discussion against him, using the *Tatva* system; and were greatly surprised that they could not overcome him therein. Seeing this state of the case the *Irza* king told *Manica-vasacar* that he had a daughter born dumb, and if *Manica-vasacar* could make her speak, then he and all his people would adopt the *Saiva* mark, and the *Saiva* way. The dumb girl was accordingly brought forward, and as *Manica-vasacar* gave, or restored, the power of speech, the king became a *Saiva*, together with his followers, and paid homage at the *Chillambram* shrine.

8. The sacred feet-obtaining section (or the beatification). The god assumed the form and appearance of a *Brahman* bearing writing materials, and an iron-pen in his hand; in which shape he came to *Manica-vasacar*, who enquired whence he was. The apparent *Brahman* said he came from the *Pandiya* kingdom, and as the fame of *Manica-vasacar's* chants in the *Tiru-vachacam* was now every where spread abroad, it was his (the *Brahman's*) desire to be permitted to write them down from the composer's own dictation. *Manica-vasacar* consented, and the chants were committed to writing, by the *Brahman;* who, having completed the whole, disappeared, together with the book. *Manica-vasacar* sought him every where in vain; and now discovering that it was an illusive form of the god, he wept over his departure. The book was however taken by the god: and deposited on one of the five lettered steps, immediately in front of the shrine. The following morning, when the attendants on the fane opened the doors, they were surprised at finding a book laid on one of the sacred steps, and paid it divine honours. On looking it through, it was found to bear the autograph signature of *Tiru-ambalan*, or the local *numen*, and it was respectfully carried to *Manica-vasacar* with the request that he would explain its meaning. To this he readily consented; and then, going with them to the presence of the image in the shrine, he there unfolded the meaning, and explained, that the said image formed its sum and substance. Having completed the exposition, a flame appeared enveloping the place, being the emanation, or effluence of the divine essence, and at the same time the soul of *Manica-vasacar*, quitted his body, and became united with the said divine essence: forming the union and identification with the divine nature, which is regarded as the highest degree of beatification. Here the *purana* ends.

Remark.—There is a close co-incidence between this *puranam,* and the Madura local legend, as far as to the end of the fourth section of this one. The Madura legend refers to the present document for the rest; briefly mentioning that *Manica-vasacar* disputed with the *Bauddhas* at *Chillambram*; and there became united with the essence of the deity. There is, I think, clear evidence, in this document, that the Madura country had not adopted the *Saiva* religion in the time of *Manica-vasacar.* The 7th section is of some historical importance; and will be of service in its place. The account of the *Tiru-vachacam* is, at the least, curious. A native proverb declares that the person who is not affected by the tale and writings of *Manica-vasacar* will be affected by nothing. This work, at the commencement, that is, in the 1st section, is stated to be the composition of *Kadavul-nayanár.*

Note.—The three MSS. Nos. 36, 37, 38, are entered in Des. Catal. vol. I. p. 201. Art. xvi with a brief account of the subject; having only one or two apparent, and slight inaccuracies.

b. Manuscript Books.

Manuscript book No. 1—Countermark 47.

Palani-puranam. The legend of Pyney.

Of this large manuscript, thirteen sections were abstracted in my last report. What follows is a continuation.

Section 14. The narrative concerning *Brahmendiran.* The *rishi* named *Angirasa* had a son who was named *Agni-tama,* a name which was afterwards changed to *Brahmendiran.* He was carefully taught; and, by his own application, became well read. After making proficiency in study, he proceeded on a pilgrimage to the whole of the *Saiva* fanes, and after visiting other places he came with a retinue of disciples to *Tiruvavanankudi* (another name of Pyney). The followers of *Brahmendiran,* greatly approved of the locality; and recommended the fixing a residence there. The whole body, by consequence, continued at that place, doing penance. At length the local deity, *Subrahmanya,* appeared; desiring to know what gift or reward they required; and, at their request, gave to the whole of them beatification.

Remark.—This section is of considerable consequence; inasmuch as it clearly marks the first immigration of Brahmans, settling at Pyney: in the same way as the first location of another Brahman colony at Chillambram was before noted. Vide 3d Report.

Section 15. The narrative concerning *Nitya-nat'ha.* This account refers to the period of the *Treta-yuga*. *Nitya-nat'ha* was a son of *Nala-raja.* He was powerful and wise. Proceeding on pilgrimage he came to the *Congu-nad* (modern Coimbatore in which Pyney was situated). He visited seven *Saiva*-fanes in that country. He built a town which was called *Raja-raja-puram.* Afterwards he proceeded to *Tiruvava-nankudi*; and there performed penance. *Subrahmanya* appeared; and, being praised by his votary, asked what gift, or reward, the latter required; who answered that he desired to reach the sacred feet (obtain beatification) without the pain of future births. The said god then instructed him in the *asktanga-yoga* (or eight-membered-meditation; that is *anima, makima, karima, lakima,* &c. Vide Oriental Historical MSS. vol. 1, p. 128); and assured him that if he practised these various forms of contemplation, he would attain final beatitude. As so many persons performed penance at this place, it acquired the appellation of *Yoga-vanam* or the site of contemplation.

Remark.—This section indicates the ingress of the military tribe to the extreme south; while a reference back to section 10 would seem to imply that the *Chera* race was aboriginal, and not *Hindu.* Comparing section 15 with section 14, there is visible a delicate reserve of the privileges of *Brahmans* above *Cshetriyas*; inasmuch as the former were beatified at once; but the latter after instruction and study.

Section 16. The story of *Chonna-cuttan.*

There dwelt in the *Congu* country a person who was called *Chonna-cuttan,* with his wife named *Kesai.* He worshipped both *Siva* and *Vishnu*; and his wife paid homage to *Lacshmi,* and *Narrayana. Perumal* (*Vishnu*) came to this beautiful country. The said pair besought from him the gift of a child. He replied that if a child were granted, it would soon die. They answered that their desires would be satisfied, if they might see their own child, and afterwards if needful it might go, they would relinquish it. *Vishnu* thereupon directed the chank (or conch), in his hand to be born as a child; and at the end of five years to return to him. It was accordingly born, and reared by its parents, as aforesaid, very carefully. They in acknowledgment bestowed many ornaments both on the *Saiva* and *Vaishnava* fanes. The child did well and grew, until its fifth year came. It was accustomed to rove about; playing in the sacred buildings and pools of water. One day when sporting in the *Camadhena-tirt'ha,* or pool so called, the remembrance of its former state revived; and it in consequence returned, and re-entered the conch of *Vishnu.* A report was brought to the parents

that their child had fallen into the pond. They were exceedingly grieved; went to the place, and carefully sought for the body; which however was not to be found. They roamed about seeking it; being beyond measure distressed at their loss. They both thought of casting themselves into the fire; so severe was their anguish. *Subrahmanya* at length appeared to them, in the likeness of a child. They were re-joiced, as he seemed to be their own child. They took him up in their arms, and fondled him; when the seeming child re-assumed his usual appearance, having six heads, and twelve arms. He told them that their child had been a gift of *Vishnu,* and had resumed its own form, as the chank of that deified personification; adding that from regard to them, and with a view to alleviate their sorrow, he had appeared to convey to them this annunciation. He further stated to them that there was no difference between himself, and the said *Perumal,* or *Vishnu.*

Section 17. The legend of *Vasumantan.*

Vasumantan was a king who resided at *Deva-puram.* A *rishi* recommended him to do penance at this place, where many others were so employed. An account of his penance is given. In a former state, or birth, he was of the *brahmanical* order, and a descendant of *Casyapa;* but in consequence of dwelling with a *Sudra* woman, he lost his caste, and sank to the level of a *Sudra.* The effect of his penance was, by means of the homage paid to *Subrahmanya,* to assure his regaining the rank of a Brahman, in a following birth, with all connected privileges.

Section 18. Account of the six faced river. *Subrahmanya,* looking from *Varáha-giri,* saw another hill; and was told by a Brahman that six torrents ran down it, uniting to form a river at the base. As the hill had six rivulets corresponding with his six faces (*Aru-muchan* "the six faced one" is a title of *Subrahmanya*), he granted to the river below this, the peculiar quality, or virtue, of washing away the guilt of every crime. In consequence of this especial privilege having been bestowed, the fane, which is situated on the said hill at *Tiru-vavanankudi,* is a superior place; and final beatification is there of certain attainment. *Subrahmanya* is represented as taking occasion to specify six places where he is worshipped, as being of especial consequence. These are *Tiru-paran-Kunram—Alavayi-carai—Tiru-chendur—Tiru-vavanamkudi—Tiru-varacam* and *Para-mutal-choli:* the latter being, as I am informed, another epithet of Pyney.

Note.—The abstract of the foregoing five sections may suffice, for the present, in continuation. The remaining five sections would properly

require to be specified somewhat more fully: the doing of which would entrench too much on other matter, which I am anxious to pass out of hand. An appropriate place for the remainder of the foregoing local *puranam*, may perhaps be found in a following report.

Manuscript book, No. 17—Countermark 910.

This document is entirely occupied with an account of different tribes, and orders of men in the *Malayalam* country. Fifteen kinds of Brahmans are specified; the *Namburi* class being at the head. Sixteen subordinate orders, or tribes, are detailed; one of them being the *Cshetriya*, or kingly caste, and another the *Samanda rajas*, or chiefs, at Calicut. Of several of the different classes, notices have appeared in the shape of abstracts from papers in the *Malayalam* languages; yet not to such an extent as to supersede the fuller details contained in this volume. They are many of them very minute, extending to a specification of distinctive modes of dress, and like details. The distance to be observed by each tribe in approaching another, is stated. An abstract of such matters would be in a manner impossible. A translation might be curious; and to some degree interesting; but it might be deferred until other documents had been previously disposed of. This book is of small size, and wholly written on stout China paper; the ink being very legible. The hand-writing is peculiar; being the Tamil writing of a native of Malayalam. The book has escaped injury remarkably well: the paste of the covers has attracted insects, but their work of destruction seems to have been interrupted; and, with common care, the book will last, as it is, for some time to come.

Manuscript book, No. 52—Countermark 1021.

According to the English label this book originally contained copies of inscriptions from the south of India. The number assists in referring to the Des. Catal. vol. 2, p. cxxvi: from which it appears to have consisted of 126 copies of inscriptions on stone and copper from Coimbatore, Caroor, and *Dharapuram*. The book, as received by me, has only the covers; all the inside being wanting. How this loss occurred I cannot say, but I return the envelope simply as received.

Manuscript book No. 50—Countermark 1019.

Section 5. Several leaves intended to have been filled with copies of inscriptions, from various places in the Jaghire, have been left blank, in the said book.

Section 6. Copies of inscriptions at *Tiru Karz-kunram*, and other neighbouring places.

1. Commemorates an extensive grant of land, with reservoirs, &c. to the image of the above fane, termed *Bhakta-varchatta-svámi*, and also a gift of 250 pieces of money, arising from the sale of a village, made in the time of *Hari-hara-rayer*, but without date of year, and signed by the donors.

2. Gift by *Canda-rayen* of 1360 *fanams*, to the said fane attested by witnesses, and not to be reclaimed. The astronomical day specified; but no date of year.

3. Gift by the son of *Canda-rayen* of 1560 *fanams*, inalienably bestowed on the said fane: astronomical date of cycle given, and Friday specified.

4. Gift by weavers of 70 *fanams*, date as before.

5. Donation by traders of a proportion of their profits; being 2 per cent. on some articles and 3 per cent. on others, to the said fane. No date of year.

6. Dated in the 42d year of *Kulottunga Chola*; a long strain of poetical panegyric being prefixed. It commemorates the gift of a tax on revenue proceeds, for the benefit of the said fane.

7. Dated in the 25th year of *Kulottunga Cholan*. Gift of 700 current *cash* (probably gold cash) for the purchase of a village, presented to the fane, to maintain a perpetual light, during their own time, and that of their latest posterity; by two brothers, landed proprietors in the neighbourhood of *Madurantacam*; attested by several witnesses.

8. Dated in the 33d year of *Kulottunga Cholan*. It commemorates no gift; but seems to be a record defining limits and privileges.

9. Gift of 22 cows to provide butter-oil, for the maintenance of lights in the fane, by persons who subscribe the deed of gift.

10. Dated in Sal. Sac. 1328, in the time of *Hari-hara Bukha-rayer*. Gift by him of land for the service of the above mentioned fane.

11. Dated also in Sal. Sac. 1328. Gift of land and of 60 gold pieces by *Bukha-rayer* to the fane.

12. Dated in Sal. Sac. 1320 in the time of *Deva-rayer* of the line of *Hari-hara Rayer*. Bestowment of land in free tenure to the fane.

13. Dated in the 13th year of *Vira Pandiya-dever.* Gift of land without any reserves to the fane,

14. Dated in the time of *Sri-vira Vijaya Bhupati-rayer* (all titular names), cycle year only mentioned. Gift of land, by a union of various classes of people specified, for the advantage of the fane.

15. Dated in Sal. Sac. 1330 in the time of *Bhupati-rayer.* Gift of 32 cows, &c. to the fane, for the supply of oil for lights to be maintained therein.

16. Dated in the 1st year of *Sambhura-dever.* Gift of 350 fanams for the service of the image in the same fane.

17. Dated in the time of *Deva-maha-rayer* son of *Vira-vijaya Bhupati-rayer.* Gift of the proceeds from the sale of these villages; amounting, in all, to 820 fanams (kind not specified); from persons subscribing their names.

18. Dated in the 21st year of *Tribhuvana-dever.* Gift of land for the service of the fane.

19. Dated in the 1st year of *Sundara Pandiya-dever.* Gift from several persons of the *Kōn* tribe (bearing that affix to their names). Gift of cows, &c. to provide butter-oil for lights in the fane.

20. Dated in the 1st year of *Sundara Pandiya-dever.* Gift of a proportion of rice-grain, at the time of harvest, and 22 fanams, from four *Pandarams* to the fane.

21. Dated in the 1st year of *Sundara Pandiya-dever.* Gift of 67 fanams to the fane by certain persons, who subscribe their names.

22. Gift of 850 *fanams,* for the service of the fane; no date of year specified: incomplete at the end.

23. Dated in the 3d year of *Kulottunga Cholan.* Gift of land, to the fane.

24. Commemorates the building of a *Mantapa,* or porch, by *Canada rayen,* for the accommodation of all the *rishis,* and the 330 millions of celestials.

25. A fragment of a few words; of no connected meaning.

26. The same.

27. A fragment, somewhat longer, but incomplete.

Remark.—The copies of the foregoing inscriptions contained in section 6, are in good preservation; both as regards ink and paper.

Section 7. Copies of inscriptions at *Tiruporur (vulg.* Tripaloor) and other places between *Mavaliveram,* and Madras.

1. Gift of a proportion of rice-grain, for the maintenance of Brahmans at Tripaloor: the fane is one of *Subrahmanya.*

2. Gift of a village to the said fane; from persons who subscribe their names.

3. Dated in the 15th year of *Vijaya-Canda Gopala-dever.* Gift of 5 cows to supply butter-oil for a light in the fane.

4. Dated in the 10th year of *Vicrama Cholan.* Gift of a piece of land to the fane by private individuals.

The preceding are the only inscriptions at *Tiruporur*; but it is added in a note that the fane was built in Sal. Sac. 1429; and that some much defaced inscriptions remain, having been chipped out by a chissel. The writer asks instructions as to whether more labour and pains, ought to be bestowed on them, or not.

Copy of an inscription at *Taiyur.*—1. Dated in the time of *Achyuta-deva-rayer* in Sal. Sac. 1458. Gift by an individual named *Titta Pillai*, son of *Appaiyar*, of a village for the support of the fane, with a heavy denunciation against any one alienating the donation to other purposes.

Copy of an inscription at *Vellichakollutur.*—1. Gift of a tax by weavers on the productions of their looms for the benefit of the fane.

Inscription at *Tiruvottiyur.*—1. Gift of a certain proportion of grain; for the use of the fane, by persons whose names are subscribed.

Inscription at *Tiruvadantai* village.—1. Dated in the 11th year of *Sri Covi raja Kesari.* Gift of land for the service of the fane of *Varaha-svami* (of the appellative *nitya-calyana-svami*, a name of the image at *Covalam)* by certain *Vaishnavas*, who commemorate the donation by this inscription.

2. In the time of *Kullottunga Cholan.* Gift of rice, and other matters to the Brahmans of the fane.

3. Dated in the 19th year of the rule of *Covi Kesari.* Gift of a tax in kind, of rice and other agricultural productions, by cultivators, to the shrine.

4. Dated in the 8th year of *Cola-raja (Chola-raja ?)* " the decapitator of the *Pandiyan.*" Gift of a proportion of grain from the harvest, by cultivators.

5. Dated in the 8th year of *Ventaratipan.* Gift of 93 goats, to provide butter-oil for lamps.

Inscriptions at *Mamalipuram.*—This name seems to be intended for

Mavaliveram. It commemorates a gift of grain from persons subscribing their names; but is without any date.

2. Gift of land by persons subscribing their names. No date.

3. Dated in the time of *Deva-rayer.* Gift of 332 pieces of gold, and of some smaller sums for the service of the fane, for gathering flowers to adorn the image, and similar matters; the various allowances for different purposes being minutely specified.

4. Gift of land with a reservoir fertilizing the same to the *Vaishnava* shrine.

5. Gift of twenty-two cows, to provide a lamp with butter-oil. No date.

6. Gift of a piece of land with cocoa-nut trees growing thereon. Cycle year only specified.

Section 8. Tamil inscriptions extracted from a manuscript (a pencilled explanation, in Colonel Mackenzie's hand-writing, no longer legible).

1. An inscription of *Deva-rayer* Sal. Sac. 1270.

The purport of this inscription is to commemorate the construction of an *agrahâram* for Brahmans by *Deva-rayer;* who is termed the son of *Hari-hari-rayen;* and his ancestry is traced upwards. *Bukhan* is said to have founded *Vijayanagaram,* on the banks of the *Tungabhadra* river. *Deva-rayen* was respected by other kings, and praised by Brahmans, when they came into his presence. A minute specification is given of the location of Brahmans, distinguished by their *gotra,* or tribe, and by the Veda, which they studied: the entire inscription is curious.

2. The genealogy of the *Rayer* dynasty is given. It is dated in Sal. Sac. 1300, at *Pennaconda.* It commemorates the building or foundation, of the town of Pennaconda, ascribed to *Sika-deva-rayen.* It is very brief.

3. Dated in Sal. Sac. 1303. This inscription gives a particular statement of the parentage of *Bukha-rayen,* the founder of the *Rayer* dynasty; mentions his brothers, the name of his wife; and states his son to have been *Hari-hara-rayen.* It is of considerable importance; particularly as to the parentage of *Bukha-rayen.*

4. The said *Hari-hara-rayen* built an *agrahàram* for *Brahmans,* and the distribution of the said alms-house among them is specified, by tribes and portions.

5. Dated in Sal. Sac. 1701. The commencement of the lunar-race is given, and deduced through the line of *Crishna* of the *Yadava*-race, rul-

ing at *Dwaraca-puram.* One of this line, named *Sáluva,* saw a hare chase a tiger, and considered the place to be propitious............... (Here there is a chasm, by reason of some leaves being cut out from the book).

19. *Crishna-rayer, Achyuta-rayer, Rama-rayer, Tirumala-rayer* and *Sada-Siva-rayer*, are mentioned ; and an account follows of a repulse experienced by *Narasingha-rayer* in an attempt to take Seringapatam. The assumption of power by *Rama-rayer,* and his defeat by the Mahomedans are stated. He was succeeded by his son *Sri-rangha-rayen* who ruled at *Pennaconda.* He established his brother, named *Vencatapati-rayer*, at *Chandra-giri,* and another brother named *Rama-rayen* at Seringapatam. After the death of *Rama-rayer*, a district chief took Seringapatam, and the news coming to the knowledge of the Pennaconda ruler............

(The following matter is wanting, owing to the leaves having been cut out from the book. This last fragment is not an inscription : but part of some historical narrative the value of which cannot now be determined).

General Remark on MS. Book, No. 50.

The whole of the contents of this book have been carefully investigated, and brief results indicated in different portions of my several reports. Copies have been taken of various portions where the ink was found to be pale, and becoming illegible. Section 6, herein noted, is in good preservation, and has not been re-copied. A copy has been taken of section 8, because, though unhappily very imperfect, its contents are of value. The whole examination gives no results of great antiquity. There are some few documents of consequence. The greater portion are of little historical use, from wanting the dates of the *Sacai* year ; but they illustrate the spread, and influence of Brahmanism ; and give views of the practical working of idolatry, which in any bearing upon the improvement and elevation of the people at large, are of momentous import. As such, may the brief outlines given be well considered.

Manuscript book, No. 13—Countermark obliterated.

Section 1. Account of the *Nayanmar*, in the Malayalam country.

A specification of local customs, and usages of four subdivisions of the *Nayanmar* named respectively *Ilam, Surubam, Tamil,* and *Patha-mangala.* Social intercourse ; what persons can enter the houses of others. Astrological precautions, before determining on marriage. Mode of con-

ducting marriage ceremonies. Plurality of husbands; and consequent manners, of great laxity. Modes of proceeding, consequent on the death of any one of the parties. Modes of dress. The *Nayanmars* have lengthened ears, like the *Maravas* of the Tinnevelly country; and, like them, wear jewels in their ears. (This custom on enquiry I find to be peculiar, in Malayalam, to the *Nayars*). Other details concerning the intercourse, of the most licentious kind, between the wives of the *Nayars*, and the *Namburi* Brahmans. Modes of subsistence. The *Nayars* sometimes officiate as accountants; but they disdain any trading, or trafficking, employment. They eat flesh, and drink strong liquors. They are debauched, and irregular, in their habits. They are destitute of honesty and moral principle; so much so, that their word merely is never taken; and people will trust to nothing but written security from them. Their morning and evening meals; utensils, habitations, and connected matters. Depraved, and polluted, as this class are stated to be, yet it is observable that if one of a lower caste, or if an outcaste, trespass in even so small a degree the prescribed distance of approach, the *Nayar* must bathe in order to wash away the contamination; thus following a very common error of making a ceremonial contamination a matter of greater magnitude than moral turpitude. Some other details follow, concerning the modes of proceeding by parents, in marrying out their children. Means employed of providing for children, who have lost one, or both, of their reputed parents.

The customs of the *Potemar* are stated. They are a class of Brahmans, and have their own customs. Some of these indicate their having come from the *Tuluva* country; that is, the most northern division of Malayalam.

Remark.—The foregoing paper affords further attestation of the affinity, as to origin, between the *Maravas* and *Nayars;* heretofore observed in a note on a paper formerly abstracted.

Sections 2 to 16. Are entirely occupied with minute details, as to allowances daily to temples; revenue proceeds; and the like; of no consequence whatsoever; and therefore passed by, without being re-copied, and not susceptible of abstract.

Section 16. Boundaries of *Puntalam.*—From a slight mistake of my directions the writer copied this section: as it is somewhat more connected than preceding matter, but it is of no consequence.

Section 17. Account of the fane of *Mahadeva*, at *Puntalam.*—The etymology of the word *Puntalam*, is from *pú* a flower and *St'hala*,

a place; which by the rules of Tamil orthoepy becomes *Puntalam.* What little is stated is not of any consequence.

Sections 18 and 19.—The former a rude attempt to delineate the fort of *Conatur,* with its fane; the latter a trifling account of revenue proceeds; passed by as useless.

Section 20. Notice of the *Panikar* living in *Conatur* district.—A few details concerning this class have been copied; but of trifling consequence.

Sections 21 to 26 having little or nothing in the book answering to the section titles prefixed, the few loose and insignificant details given, have been passed by.

Section 27.—Account of *Vámanapuram* the residence of the *Atingal* chieftains.—A brief statement concerning this town has been copied; but it is insignificant.

Section 28. Account of the *Irzhavar* tribe.—A few unimportant matters, respecting them, have been copied.

Sections 29 to 32. Indicated in the section-titles to contain revenue details, have only 3 or 4 pages answering thereto in the book, of trifling and insignificant matters.

Section 33. Account of the *Nambiyar* Brahmans at *Cochin.*—A legendary statement as to their origin.

Section 34. List of commercial goods in the district of *Puranàd.*

Section 38. Legend of *Mánica-cshetram,* at the village of *Irankalgudi.*—An ascetic discovered a jewel; which, in process of time, came to be worshipped as a god.

Section 42. Account of *Pulapanàd.*—Some legendary matter of no value.

Section 44. Account of *Codagnalur.*—The derivation of the name is given.

Remark.—This book having been found to be in a wretched plight as to paper, ink and general preservation, was given to a copyist to do what he could with it; and the results are stated in what goes before, after hearing the whole read over. They are of so little value, that the book might have been allowed to perish; though it is my wish not to permit any part of the collection to do so if it can be preserved; that is if recoverable.

Manuscript book, No. 7—Countermark 900.

Section 1. Details concerning the Brahmanical, and other tribes, in Malayalam.—Some details concerning Brahmans, and divisions of tribe, originated by *Parasu Rama.* Afterwards the *Musu-jati,* a tribe of temple servants are described, and the *Vaitiyar,* or medical class. The *uril-parichi* deduce their origin from the circumstances of a war entered into by *Kulasec'hara Perumal.* The *Cshetriya-jati,* or military class, is subdivided into three tribes. *Ambala-vási* or dwellers in a fane, are of mixed origin. The *Pushpacanmar* have no restriction, as to not marrying a second time; they gather flowers for the use of the idol. The *Pshárodi,* derived their origin from a Brahman who forfeited the privileges of his tribe. The *Variyar* derive from the marriage of a Brahman with a *Sudra* woman; and perform various offices, as servile assistants to Brahmans. The *Marayan-jati* beat drums, &c. in fanes at the time of offerings. The *Curupu* play a kind of lute. *Chákiyár-nambiyár* are minstrels, who sing the praises of Brahmans, and kings. *Atizal* were Brahmans, who from becoming worshippers of the *Sacti,* or negative power in nature, became degraded. A list of subdivisions of the *Sudra* tribe follows.

Section 2. Account of the fane at *Tirukan-kodu* from the writing of a Brahman.—In the year of the Collam era 982, two brothers gave some land to this place. There is nothing else in this very brief section.

Section 3. Account of proceeds of different kinds of lands in the *Cavalapar-nad.*—This short paper relates to revenue proceeds, of no permanent consequence.

Section 4. The genealogy of the zemindar of the said district, is in the Telugu language. (See that part of this report).

Section 5. Copy of a record concerning *Calicut,* preserved in the hand-writing of a *Senatipati,* written before the times of disturbance.—(This section is in the Tamil character, and in the midst of Tamil documents; but, on examination, the language was found to be Malayalam).

The above mentioned *Senapati,* or commander of troops, was in the service of the *Calicut-raja.* He was of the *Taracal-vamsa;* a family which possessed peculiar privileges, as military chiefs, in connexion with the *raja.* Mention is made of one such chief, and of the subsequent want of posterity, supplied by adoption. Various kinds of deeds, grants, orders, and the like, were not valid, merely on the signature of the *raja*; requiring also that of the chief of this family, and the signature of another minister of the *Mangnatacha* family. These things bear on the local customs, and government, of that part of the Malayalam country; but there does not appear to be any thing of historical interest of a general kind.

Section 6. Geographical account, written in the Malayalam language.—In this paper also the characters are Tamil, the language is Malayalam. The document is an itinerary, or travelling journal, of one named *Canyuru-Namburi,* during a period of 11 or 12 years, between *Collam* era 863 and 874, respecting his journey from the Malayalam country to *Casi* or Benares; stating the names of places of repute, as shrines, or bathing pools, visited by him; and lying intermediate between Benares, and Ramaseram. He further adverts to Himalaya, on the north, and to *Irza* or *Singhála,* on the south; the latter of which he terms *Lanca.*

Section 7. Copy of a palm-leaf record of the *Cutheri-vatta-nayar* of *Naduvattam* in the *Palcad* district.—This section is also Malayalam, in the Tamil character. It relates to the local rules, or customs on which the fief or barony, of the said *Nayar* is held from the *Samotiri-raja,* or Calicut ruler. On the installation of a new *Nayar,* a certain sum is paid to the minister of the Calicut ruler. On the death of a *Nayar* information must be sent to Calicut, with the mention of the legal apparent successor whose nomination needs confirmation from Calicut. The expences incurred on occasions of the installation, marriage, or funeral, of a *Nayar,* are stated. The form of writing to the Calicut chief, announcing the death of a Nayar, with the legal successor, and the form of the Calicut ruler's official reply, when affirmative, as to a successor, are given.

Section 8. Copy of an old record of the *Puthucheri agrahâram*, preserved in the hand-writing of the *Manradiyar* of *Vadacheri*, in the *Palcad* district.—The *Manradiyar* was a petty chief who held a small country, of a few leagues in circumference, which was forcibly wrested from him, by the Travancore king; and afterwards made over to the Calicut ruler. The chief portion of the paper relates to the laws, and regulations, of the said small barony; as to marriage customs, and observances; domestic rules, and restrictions; rights, and privileges of Brahmans; and the illegality of any sale of land, which must go by hereditary descent. It is of local importance only; but the existence of distinct laws, in various small districts, confirms other indications, as to the want of extensive imperial power in the Malayalam country.

Section 9. Account of the fane at *Tiruvâlattur.*—There are some loose and unconnected lines as to *Chittur* village, and *Tiruvalattur* fane, but mere fragments, and by consequence of no use whatsoever.

General Remark.—This book was observed to be in a damaged state: it has (with the exception of sect. 9) been restored; section 1 to 3 in the Tamil language: section 4 is in Telugu (see that portion of this report) section 5 and 6 as found in the Tamil character; but section 7 and 8 are copied in the Malayalam character, as best suited to the Malayalam language. The Tamil character disguised the language of the latter sections, at first; especially as the opening sections were wholly in Tamil. The importance of the contents does not seem to be great; but, on the whole, it may be of some use to have rescued, what is of any consequence, from destruction.

Manuscript Book, No. 12—Countermark 905.

Section 1. Account of a shrine of *Crishna* at the village of *Ambalapurai* in Malayalam.—A child troubled a *Sannyasi*, by doing mischief to sacrificial implements which made the said ascetic angry; whereon the child disappeared, and was discovered to have been an apparition of the god. Much inane matter connected therewith; leading however under the influence of superstitious credulity, and of the *Namburis*, to the construction of a fane, with its shrines, out-buildings and appurtenances of festivals, allowances for them, and grants in land: the whole dedicated to the service of *Crishna*. At a late period the minister of the Travancore *raja*

made war against the head *Namburi* of this place. The details indicate that the head *Namburis* had acquired great influence, and consequence.

The account was collected by *Nitala-Narrayan*, who visited the various fanes accompanied by Mr. Ward. According to the description given, this one with its various appendages, is of more than usual magnitude, and splendour.

Section 2. Account of the Syrian Christians, in Travancore.—*Nitala-Narayan* states that being in company with Mr. Ward (an officer of the survey department) a document in the Lebbi language (probably Syriac) was explained to him in Tamil, which he embodied in the contents of this paper.

At a former time seven persons of a strange religious persuasion came to Travancore; among whom the name of Mar Thomas occurs. The king of the country had previously received some admonitions respecting them in a dream. They called on the king to embrace their system, and to allow them to build places for their mode of worship. The king demurred to their claims and said these must be proved. He also summoned a council of *Brahmans*, enquiring if the new system ought to be received; who replied most certainly not. The foreign persons ascribed to themselves the faculty of retaining the soul (when departed from a body) in the air above, and of recalling it, so as to re-animate the body; and, as stated, gave a proof of this power in the case of one among themselves. The king, however, resisted their claims. Soon after the king's younger brother died; whereupon the recently arrived strangers told the king that if he would build seven churches in different places they would restore his brother to life. The king made the promise, and the body of this brother became re-animated, awaking as if out of sleep. In consequence both the king, and his brother, adopted the new system, and along with them sixty-four householders with their families: these received the initiatory rite of baptism. Thirty-two householders refused to adopt the new mode of credence; and created disputes. The younger brother requested from the king one-tenth of his revenues, which the king granted; and, with the proceeds, the younger brother had seven churches built, in different villages. Mar Thomas was killed, and afterwards respectfully buried. In consequence of the disputes, a message was sent to Syria; whence a person came, on board ship, as spiritual superior of the Christians. At a later period *Manica-vasacar*, a person who chanted panegyrics, came to Malayalam, and disseminated the *Saiva* five-lettered system; teaching to swallow the *Saiva* compound of five substances; and to use the

Vibuthi, or sacred ashes. He drew away several families. The head of the Christians received various privileges and immunities from *Cheruman Perumal*, who always directed the election of the *Metran*. A council, or synod, was formed for the settling of disputes. Other details are given; with mention of the first arrival of the Portuguese, termed the Cochin-Feringhis. An interference of a Roman Catholic, claiming authority over the Christians, is mentioned; whom the Cochin *raja* put in fetters. A reference was made to Rome on the subject. Subsequent matters are stated; chiefly relating to discussions between the Syrian, and Roman Catholic Christians. A Roman Catholic bishop arrived; whom the Syrians refused to recognize. The affairs of the Syrian church in Travancore are narrated, down to a recent period.

REMARK.—The preceding abstract is much too brief; and very imperfect. But I have allowed it to be so, partly because it is probable that I may take an early opportunity to translate the document, which is of some length; and, as it seems to me, of some value as an authority.

Section 3. Account of the fane of *Callara-cota* in *Malayalam.*—Legendary reference to birds killed with an arrow by *Arjuna.* A fane was built; but there is no *St'hala-puranam* relative thereto.

A sort of itinerary follows, written by *Nitala Narayan;* briefly mentioning heathen edifices visited by the way. Four of these have only a few lines appropriated to each; with trifling details of no value. In the table of contents, each of these short paragraphs is entered as a section. Section 8, relates to *Vallabha Cshetram,* concerning which a long legendary account is given, but as puerile as can well be possible. A few dates of the early part of the *Collam* era are stated, with mention of some rulers, which may be of use. The place seems to have risen to celebrity, and to be one of much resort at its festivals. Sections 9, 10, 11, 12, are merely brief paragraphs of an itinerary: the subjects relating to places of inferior note.

Section 13. Account of the fane of *Panniyanna-naru-cávu Bhagavàti* near to *Manàr,* in the district of *Tiruvalla.*—With this section a third division of the manuscript book begins. Some legendary matter, of no consequence, is stated. It then appears in the statement, that an annual human sacrifice of peculiar atrocity, was accustomed to be offered. The person proper to be so sacrificed was a woman, pregnant with her first child. Such a woman, being selected was brought to the shrine; and there killed by being beheaded with a sword; so that the head rolled up to the image, and the

blood of the victim was sprinkled thereupon. The origin of this sanguinary sacrifice, as to any date, is not specified; but it is stated to have been regularly of annual observance, down to the year of the *Collam* era 918. In C. E. 919, an *ávésham* or possession of the spirit resident in the said image, came on a by-stander, at the time when the sacrifice was to have taken place, directing that for the future human sacrifices at her shrine should be discontinued. (That year corresponding with A. D. 1743 the said afflatus of the evil spirit, can be accounted for, as a precautionary measure). From that date human sacrifices have been set aside. Moreover the posterity of the woman and child, spared on that occasion, now bear the name of *Adichamar*, who live in a village divided into the north and south quarters, being four or five households, and inclusive of their children, amounting, when the account was written, to 40 or 50 souls. They receive offerings made to the shrine; and by an order from the *rajah* they are exempted from the payment of any taxes. There is a small river near the said fane, and since the Collam year 920 annually on the day when the sacrifice used to be made, the headless trunk of a dead body is seen on the river bank. No explanation of this circumstance is offered; and, if any be asked, the only reply given is that it is "a divine secret."* (The inference of course is, that the sacrifice was only publicly discontinued, but is still privately practised, possibly during the night). At the present day a public sacrifice of sheep is substituted for the human sacrifice. At this fane there is neither inscription nor *St'hala-puranam*.

Section 14. Account of the *Siva-cshetram* at *Corandi*, in the same district.—In the time of *Parasu-Rama*, an evil spirit built this fane, in the course of one night. No females are allowed to enter; not even the queen. These must pay homage outside, men only may enter withinside.

Section 15. Account of the village district of *Sanganacheri*, with its village of the same name.—There is nothing of any consequence in this section, beyond the mention of the building of the village fane.

Section 16. Account of *Siva-cshetram* of *Candiyur* in the *Mavalikarai* district.—The name of the district is derived from *Mahabalichacraverti*. The fane is one of *Crishna*. The term *Candiyur* arises from *Mahabali* having been resident, or seen there. (An example of

* *Daiva rahasya.*

the liberties taken as to names and localities). It had its own chief; but in *Collam* era 920 it was seized by the Travancore *raja*. Access to the *St'hala-purana* could not be gained.

Section 17. Account of the fane of *Maha-deva* at the village of *Pandala*.—The name of the village seems to be properly *Puntala*, meaning "a flower garden." This district had its proper chiefs. A *Pandiyan* king ruling over *Ten-Casi* (the southern Benares), having no offspring, adopted a child; but the people of the king refused to recognize that adoption. In consequence the rejected person took away much wealth from the place, and with it retired to Malayalam; where he purchased extensive estates, forming this district: over which he, and his posterity, ruled. It was however forcibly seized by the Travancore *raja*; and a few descendants only of the original proprietors remain; these being now poor and miserable.

Section 18. Account of the fane of *Maha-deva* in the village of *Venmanni*, of the *Puntala* district.—Certain lands were made over to the fane, in the hands of Brahmans of the *Potemar* tribe; who, in consequence, conducted the usual ceremonies and offerings.

Section 19. Account of *Tumbuman*, a fane of *Subrahmanya*, in the *Puntala* district—A possession of the spirit of *Subrahmanya* came upon a certain Brahman, ordering a fane to be built; which was accordingly done. Nothing further is mentioned.

Section 20. Account of the *Sevacshetram* of *Senganur*, in the *Mavalikarai* district.—Legendary matter, as to an appearance and marriage of *Siva* with *Parvati*. At the time of the primary marriage the concourse was so great that the earth could not bear the burden. A certain *rishi* received an order, in consequence, to go to *Senganur*. He objected to the doing so, without having seen the marriage ceremony; but was dismissed with the assurance that *Siva* and *Parvati* would come thither and be married, for the fourth time. The promise was accordingly fulfilled; and on that event the construction of the fane, and observance of its festivals, are made to depend. *Parvati* being subject to ceremonial desecration (according to the custom of women), ceremonial homage should not at those seasons be paid; but a *Namburi* Brahman ignorantly going to the shrine, at such a time, was violently assaulted by the spirit of the image, and afflicted with severe visitation of

the variola fever. A *Tantri*, of another class of hierophants, gave a proper explanation of this circumstance; in consequence of which, processions were formed to carry the image to the river to bathe, after the said time was past. Festival observances are connected with these processions. (To all evasions as to images being only tokens of remembrance of one Supreme, assisting the mind in His worship, such instances as the preceding may be opposed in reply. The puerility of idolatry, amazing as it is, could hardly proceed further than in the aforesaid example: it is on this account solely, that I allow of its mention). The fane was burnt to the ground in *Collam* year 940; and not a vestige remains.

Section 21. Account of *Armulai* fane, in the district of *Tiruvallà.*—Reference to the times of the *Pándavas,* and to five places dedicated by *Bhishma* to *Bhu-devi* or the goddess of the earth, of which this was one. At the festivals large bamboos (termed *Mulai*) were brought from the mountains, to form a booth before the fane: whence the name *Armulai* (six bamboos) is derived. Certain old observances formerly existed; but have not been revived since the place was burned down to the ground in C. E. 940 (A. D. 1764).

Section 22. Account of the fane of *Pat'ali Bhagavati*, in the *Cottakarai* district.—A spirit of *Bhadra-Cali* seized various animals as tigers, alligators, and the like; doing much mischief to the country. She also appeared to three persons in a dream; ordered a fane to be built; and promised in such case, to guarantee the country from hostile invasion. In consequence an image was painted on glass, according to the form of her appearance in vision; the same was placed, and ritually set apart by *Pratishta*, in a fane built to her honour: in which the usual observances were continued.

Section 23. Account of the fane of *Mannádi-Bhagavati*, in the village of *Mannádi.*—A potter, and his wife, lived on the banks of a stream; where a ferry boat was stationed. Two *Brahman* women, and two *Sudra* women, called to the potter's wife, one day, to send over the boat; which she stated herself to be unable to do. They bid her loose the boat; and it would come of itself. She obeyed, and the boat went over, and returned. The four females thanked the potter's wife; and announced to her much good. She begged of them to lodge for the night; to eat in one hut; and sleep in another one. They consented: and the potter aided his wife in procuring for them fruits, and other refreshments. In return they announced to him, that he would be chief of the district. During

the night all four were found to have disappeared; and a possessed *Caradi*, or black bear, appeared; commanding in the name of *Bhadra-Cali* that a fane should be built, which was done. The potter, and his wife, by means not stated, became possessed of the district. In bringing offerings to the shrine, the people who do so present them to the descendants of the said family.

Section 24. Account of the fane of *Pávumpávi-dever*, in a village of the same name in the *Manapalli* district.—The origin of this fane is ascribed to the following circumstance. A wood-cutter in the service of a *Nayar* when performing his work in the woods, whetted his instrument on a stone; and some others did the same. During three days nothing particular occurred; but on the evening of the fourth day, when the instrument was being whetted, blood flowed forth from the stone. The man told the circumstance to the *Nayar;* who came, together with three or four *Potemar* Brahmans. These, supposing it to be some god, had a booth erected over it; which in process of time became a shrine and fane; having its attendants, festivals, offerings, and the like, as usual in other places.

Section 25. Account of the fane at *Cáyan Colam*, belonging to the *Concani* people.—Formerly, and more than three hundred years ago, in consequence of a disturbance in the *Concan*, several persons emigrated thence and came to Malayalam, where they received permission to settle, from the Cochin raja. In consequence, they formed a distinct community; and built for themselves fanes: the one mentioned among others; connected with the usual observances.

Section 26. Account of the mosque of the *Iona-mapula* people in Travancore.—Their cazi, and some other leading persons, are mentioned. Their pecular usages, and customs, are adverted to. Their class is said to have received great increase from the accession thereto, as well of *Namburis*, as of other people.

Attached to this section, is a further brief mention concerning the Syrian Christians termed *Nasrani* (that is Nazarenes): it chiefly relates to ancient books. One, written four hundred years since, is stated to be in the old *Malayala-lipi* or character. Others are spoken of as in the Syria *lipi*, and are probably intended to denote the old Syrian MSS. of the Scriptures; one of which was purchased by Dr. Buchanan. The name of Mar Thomas herein occurs; and also some mention of the

Syrian bishops; but the brief notice is such as a Brahman, and a stranger, might be expected to write. There does not seem to be any wilful prejudice.

Section 27. Account of the fane of *Rani Cavu*, in the village of *Rampulam* in Travancore.—It belongs, as hereditary property, to a *Namburi* Brahman who officiates. Little else is added, and besides many letters have been destroyed by insects.

Section 28. Account of the fane of *Nangaiyar Curangnari*, in Travancore.—Fabled to have been the hermitage of *Mricandiya-rishi*. A woman and child, passing that way, bathed in a neighbouring pool; and meditated on *Vishnu*. In consequence *Vishnu* personally appeared, and *Mricandiyar* seeing this appearance, there placed an image of *Vishnu*, which now receives all customary honours.

Section 29. Account of a fane of *Subrahmanya* at *Aripattu*, in Travancore.—The circumstance chiefly referred to in this paper is that of a great number of Brahman children being fed at this fane; and spoken of as belonging to it. A superstitious dread of saying, or doing, any thing against them prevails. *Rama-raja* of Travancore, once seized and imprisoned one of them, for some mischief committed: for doing so his arm swelled; and he released the boy, paying a fine to the fane, and apologizing for his ignorance. Hence no one dare speak against the said children; without incurring the anger of *Subrahmanya*. The document has suffered great injury from insects.

Remark.—This book was put into the hands of a copyist to be restored, on account of its greatly injured state by *termites*. The doing so has only been partially successful; many omissions of letters, words, and sometimes sentences, remaining. The contents are of greatly differing interest, and value. Heathen superstition is herein painted by the hand of *Nitala-narayan*, himself a Brahman, in its most puerile form. Moreover the shocking cruelty mentioned in section 13, can hardly escape notice. Surely no one can regret that Christianity has planted its foot, diffusing more genial influences, in that very neighbourhood.

Manuscript Book, No. 53—Countermark 1027.

Inscriptions on stone, and paper grants in the Malayalam country.

The materials on which this book is written, are China and country paper; and with some mere memoranda in pencil. The language is quite a *melange ;* consisting of a little Malayalam, some Sanscrit *s'ocas*, a large proportion of Tamil, mingled with *Grantha* letters, and some few portions of documents in what is termed Malayalam *lipi* (characters). A perusal of the whole shews the contents to be incriptions, but of no considerable antiquity : being subsequent to the formation of the *Collam* era, and entirely referring to grants of land and other immunities, to fanes, and their attendants, by the raja of Cochin and a raja of *Cherckal ;* the origin of both of whose power is subsequent to the division of the country by *Chermman Perumal.* Such being the case I have neither thought these documents worth minute abstract, nor the book worth re-copying where practicable. At a subsequent period, if leisure or opportunity occur, it may be looked at again, and any documents that may be in danger of perishing can then be restored. The book will continue legible as it is, for a few years longer.

Manuscript Book, No. 12—Countermark 54.

Muppanto'tilulà a panegyrical poem on *Sôma-nát'ha*, the tutelary god at *Muppantotti.*

This book contains a poem, of the kind termed *ula*, referring to the fane of *Sóma-nat'ha*; and consisting of seven *adhyáyas*, or sections; the subject of each section referring to a distinct *sacti*, who is represented as coming to the shrine, and becoming enamoured by the perfections of the idol. The book is somewhat damaged by insects, and the ink is rather pale. I deem it however unworthy of restoration.

NOTE.—The entry in Des. Catal. vol. 1, p. 177, art. 38, would have led me to expect something better from it. However there remains a palm leaf copy No. 228 to be examined ; referred to a subsequent report.

Manuscript Book, No. 40—Countermark 336.

Account of *Tirunamalai*, or Trinomalee.

This book is a thin duodecimo; with only about one third written. Its object is to commemorate the visits to the shrine, of four kings, or local chiefs ; that is *Vajránga-Pándiyan ; Sambhava-rayer ; Valala-rayer* and *Devà-maha-rayer.* These persons, on their visits, made certain additions to the fane. In the times of disturbance, occasioned by Hydèr Ali, several documents belonging to the place were lost.

Remark.—Though this brief mention of the contents is probably sufficient, as to any valuable purpose; yet as the papers are loose, the country paper very thin, and partly injured by insects, I have on the whole thought it as well to have it restored.

Note.—The book is entered in Des. Catal. vol. 2, p. L. art. 40.

Manuscript book, No. 8—Countermark 762.

Section 1. Account of *Periyobaiya Condama-nayak*, local chief of *Ayacudi* in Coimbatore.—The account commences with the dates of C. Y. 4400, and S. S. 1321, when the head of this line was despatched, by the Padshah of Delhi, against the Mahrattas. A sanguinary contest occurred, leading to an explanation, and subsequent agreement. *Ubaiya Condama*, was afterwards invested with honours and distinctions. He, with his family, emigrated in consequence of the Padshah, whom they served, requiring wives from their tribe; to which they could not consent. They settled in the south, at *Ahóbalam*. The defeat of the *Pandiyan*, by the *Chola-raja*, subsequently occurred; leading to the appeal of the former to the *Rayer;* and the sending of *Nagama Nayakar*. His usurpation; the sending of *Visvanát'ha* to bring his head; the accession of *Visvanàt'ha* to the rule at Madura; the building of a new fort; the appointment of *Ariya-muthalaiyar* to be chief minister of state, are narrated. Subsequently there is legendary matter to account for the establishment of the fane of *Ahóbala-isvara*. The first of the line ruled there as a feudal chief for 30 years: his son 15 years. Other descents of the chieftainship are mentioned. There is nothing particular beyond, except the Mysore invasion; and, at a later time, the war against Tanjore. The subsequent transactions, towards the close of which the English became concerned, are narrated.

Note.—This paper as being of some value, and from the ink of the record being faded, has been restored.

A brief statement of the assumption of the *pálliyam*, by Government; and also an incomplete notice of the line of *Rama Bhadra Nayak*, follow. The first is of no moment; and a full notice on the latter has heretofore been given.

Section 2. Account of *Padmachala*, and of its fane, in the Coimbatore country.—This account professedly is extracted from the *Scanda-puránam;* some *adhyáyas* of which are copied. The object is to account

mythologically for the veneration said to be due to the hill; and to narrate the first formation of different *Saiva* emblems found thereon, with their connected shrines. Nothing beyond this simple indication of contents is required.

Section 3. Legend of the fane of *Narasinha Perumal* in the Tinnevelly district.—Under this section brief notices of various *Saiva* emblems are comprised; offering nothing deserving of special notice.

Section 4. Account of *Tádi-Combu*, an *agrahàram*, in the Coimbatore district.—The account does not ascend higher up than S. S. 1400, and has some minor details; not meriting much notice.

Section 5. Account of the fane of *Ahóbala*, named after *Narasinha-svámi.*—Legendary details concerning this fane, and others in the neighbourhood, are comprised under this section.

Section 6. Account of *Cutheraichuni.*

Section 7. Account of *Cannivádi* and *Cotapalli.*—A legend as to the first mentioned place; and other legends of places in the *Cannivádi*, and *Cotapapalli*, districts, are stated: each one brief and of no importance.

Section 8. Legend of *Manar-koil*, at Cape Comorin.—The legend is founded on a mythological fiction of *Siva's* coming to the south; and there being again married to *Parvati*, as *Canya-Cumari.* Similar legends are common to most of the *Saiva* fanes, in the peninsula.

General Remark.—This book is a little injured in the covers; and slightly touched by insects: the ink also is faded. Still it will last, as it is, and be legible for several years, with only common care. Its condition would point it out for restoration, were the contents worth it; which, with the exception of the first section, does not seem to be the case. All the remainder, at least for the present, is passed, without further attention.

Manuscript book, No. 5—Countermark 50.

This volume is a thin folio, and contains two parts; the first a legendary account of *Pâdmachala*, professedly extracted from the *Scanda-puranam;* the second an incomplete copy of the *Bhúgóla-pramánam*, or system of Hindu geography. To the legendary details of the first it may perhaps be expedient to return, more at leisure; as a few grains of wheat may be picked out of the chaff; and the more especially since the country paper is a little touched by insects and the ink in several places faded. More important matters requiring notice, this may be passed, for the present, with a general indication as to its state of preservation. The other fragment is written on Europe paper, and will remain legible a long time. It may also be referred to the notice of a palm-leaf Tamil MS. bearing the same title, with the like contents.

Manuscript book, No. 53—Countermark 1022.

The contents of this book are of a very miscellaneous description. In the index three sections are specified, as containing respectively inscriptions from Trichinopoly, Coimbatore, and Tanjore. The included matter will appear from the following brief outline.

1. At Trichinopoly, gift of land at *Ayilur*, by *Vaiyapa-nayak*, who deduces his descent from *Achyuta-nayak* to whom a long string of titles is ascribed. The gift is perpetual, to support car-festivals, and other expences of the fane of *Tiruvalesvarer*, with heavy denunciations against any alienation of the gift to other purposes.

2. A hand-writing given in by one or two individuals, specifying certain donations relative to a large lake for irrigation. One uncertain date appears, and another date S. S. 1634, with the name of *Crishna-raja-udiyar* (of Mysore).

3. A Canarese inscription. It records certain donations made by *Crishna-raja-udiyar* of Mysore, to a fane of *Visvanat'ha-svami* at *Bhuvani-kudal*, in the Coimbatore province. The grants consisted both of land and money; of which a list is given. There does not appear any *Sacai* year: but the date of course is modern.

4. Legendary matter as to the establishment of a *Saiva* emblem in the *Dharapur* district, by the command of a visionary appearance. Some gifts made to it were partly continued, and partly subverted after the Mysore conquest.

5. Details concerning an *agraharam* in Coimbatore province, with gifts made, and fluctuations of power. The establishment of the alms-house is dated in S. S. 1100. It is signed by some inhabitants.

6. Details concerning another agraharam, and fluctuations of power indicated. Constructed in Sal. Sac. 1523.

7. Particulars of grants made to the fane of *Antiyur* in the Coimbatore district, the earliest date is S. S. 1502.

8. Specification of grants to an *agraharam* at *Hobhalli,* in the *Antiyur* talook, the earliest date is Sal. Sac. 1200; the interference of Mysore kings appears. No tax paid to the Honourable Company.

9. Like matter with reference to an *agraharam* at *Samba,* going up to the 13th century of *Salivahana.*

10. An oral statement of a person concerning some claims referred to the collector.

11. With reference to an *agraharam* in *Chacra giri* hundred, mention is made of the early *Congu* line of rulers, and then of the succession of the *Rayer* dynasty. No certain date is specified higher up than the 13th cent. of *Salivahana.*

12. Particulars concerning a fane in the *Antiyur* hundred and mention of wild tribes living on a hill near it, who wear no clothes, and live on roots, or other spontaneous productions of the earth. Mention of a fort built by a *Vedar* king.

13. Particulars of an *agraharam,* and its possession going up to S. S 1105, and descending through various fluctuations of power as respects taxation imposed.

14. Matters relative to an *agraharam* at *Andiculam.* A composition as to tax in S. S. 1620, in the time of a Mysore ruler.

15. Reference to a fane of *Subrahmanya* at *Sicala-puri,* where the said *Subrahmanya* for some unknown cause chose to dwell. Mention of a teacher of great repute who had many followers.

16. Certain specialties relative to a fane which has several images within it and a great number without side.

16½. Stanzas in praise of an *amman.* In that fane there are no rites of homage practised.

17. Refers to *Agatesvara,* or a shrine of *Siva* said to have been founded by *Agastya,* and mention of his coming to the south to dissipate the darkness of ignorance. Legendary reference to former *yugas.*

18. An inscription dated in the 10th year of *Vira-Pandiya-dever.* Gift of land. Letters of the inscription, from being very old, cannot, it is stated, be read or copied.

19. Hand-writing of specified individuals relative to an *agraharam.* The earliest date given is Sal. Sac. 700, but it is doubtful if the writers did not mean about 700 years ago. Nothing answering to so high antiquity as S. S. 700 appears.

20. A local legend relative to a shrine of *Subrahmanya* as the slayer of *Suran*. Reference to the 13th *adhyaya* of the *Scanda-puranam* for an account of the splendour of the place. Certain old records were lost in times of disturbance.

21. Account of a fane at *Cadiyur* in the district of *Dharapuram*, given by *Brahmans*. Legend of *Siva* dancing in the forest. A *Pandiya* king, directed by a vision, obtained a victory in the said wilderness. The shrine has the traditionary fame of being self originated; that is of unknown antiquity.

22. Account given by *Brahmans* at *Agatesvara* fane. Some jejune matter panegyrical of *Siva* introducing the mention of his marriage at Madura. *Agastya* is mingled up with the account, and his fixing a *Saiva* emblem in the neighbourhood led to the name of *Agatesvara-vanam*. Various *tirt'has* specified with mention of the distinguished deities such as *Indra*, *Subrahmanya*, and others, who did homage at this locality.

23. Account given by *Brahmans* of *Cangaya* fane in *Dharapuram* district carried up to the *Kreta-yugam*, and a penance performed by *Brahma*. Other matter equally inane. As *Parvati* did penance there, the place seems to derive, from that alleged circumstance, its chief repute. The legend is said to be found in the *Curma-puranam*.

24. Legendary matter from older *puranas*, applied to a particular locality, with some appended jejune details. Inscriptions in troublous times were lost.

25. Account supplied by *Brahmans* of the fane at *Kannipuram*, in the *Cangaya* hundred of the *Dharapur* district. Legendary matter to account for the name. Besides older matter, the five *Pandavas* are said to have dwelt there, which affords some test of the veracity of the whole.

26. Legendary matter as to a fane at *Tiruvalur* which refers back to sixty-four great ages; to *Marcandrya-rishi*, and some later matters; of equal importance, and veracity.

27. Inscription and account of *Tiruvalur* fane in the *Valagudi* hundred, in the Trichinopoly district. *Valmica* was performing penance in this neighbourhood when a *Vedar* or wild hunter shot at him an arrow; but the sage taught him wisdom. Reference to the *Vishnu-puranam* for full accounts of the fane. It was greatly distinguished by ancient rulers; but was allowed to go to decay. *Chokarangha-nayak*, of modern date, had it repaired; and made to it a grant. It suffered from the Mahomedans. A few subsequent details down to the time of the Honourable Company. For a time its festivals were observed; but were afterwards discontinued.

28. Record of a grant by *Crishna-rayer* of various sums of money to *Vaishnava* fanes, in the Tanjore country; and a mention of his great munificence in the *Chola* kingdom.

29. A grant made to the fane of *Govinda-raja*, at *Chittambaram*, or Chillambram.

30. Record of a donation by *Achyuta-rayer* in Sal. Sac. 1461, to a fane at the same place.

31. An inscription dated in the 8th year of *Sri-coperu-singhu-devar*. Commemorating a gift of land by the *Chola* king, apparently intended by the above name, to the fane of *Sani-isvara-bhagavan*, at the same place.

32. Dated in Sal. Sac. 1400. Inscription in the fane of *Sabha-nát'ha*, to which *numen* a string of titles, verging on the ludicrous, is attributed. Donation of a village, in free tenure, to the fane; by certain head-men, whose names are specified.

33. Inscription on the eastern porch at *Chittambaram*. Dated in Sal. Sac. 1503, in the time of *Vencatapati-rayer* of the race of *Hari-hara-rayer*. Gift by certain head-men of the revenues of a village to the fane, for the customary offerings and ceremonies.

34. Inscription on the third wall. Dated on the 14th day of the rule of *Raja-raja-devar*. Gifts of fruits, and other productions, at the appropriate seasons, for the use of the fane, from persons of the *Wiyalvar* tribe. *Calinja-rayen* is the first name, but several others are included among the donors.

35. Inscription on the great porch of the fane of *Narasimha-svami* at *Manar-kovil*. Dated in *Cali Yuga* 4442, in the time of *Crishna-rayer*. The copy is imperfect, and what was given is not clear; but it seems to have been revenue arising from land.

36. On the third wall. Dated in the 10th year of *Sri-raja-raja-dever*. Gift by *Calinga-rayen*, and others, of grain arising from cultivation, for the service of the fane which contains the inscription.

37. Inscription dated in the 16th year of *Raja-raja-dever*. A gift of land by some head-men to the fane.

38. Gift of some money to purchase furniture, or utensils, for the fane in the reign of *Kulottunga Chola*.

39. At *Chittambaram* in the time of *Crishna-rayer*, in Sal. Sac. 1436, *Mannapa-nayakar*, gave a large grant of land to furnish food for the *Brahmans* to plant a flower garden and to build a choultry or *serai*.

40. At the same place. Dated in the 5th year of *Kula-Sec'hara-dever*. Gift of money to supply all customary articles of food for *Brahmans*.

41 and 42. Donations by Vicrama Tribhavana-raja.

43. Dated in Sal. Sac. 1515. *Crishnapa Condapa* gave some lands to provide butter-oil for the fane.

44. At *Sri-rangha-nát'ha* fane, on the 2d wall. Dated in Sal. Sac. 1851. Gift of a village, for the service of the said image, by one named *Vijayapar.*

45. Same place. Gift of 300 *huns*, to *Uttama Nambi*, by *Vijaya-bhupati-rayer*.

46. Dated in 1393. Gift of some money by head-men of villages, in the time of *Raja-vipada*. Also a gift of proceeds from the sale of certain lands for the service of the fane.

47. Dated in 1343. Gift of some lands for the service of the fane.

48. Dated in Sal. Sac. 1580. *Muttira Raman* gave some land, the proceeds to supply food to the *Brahmans* in the four pillared-porch.

49. In the time of *Vira-pratapa-dever* Sal. Sac. 1400. Gift of some land, for festival processions.

50. Dated in Sal. Sac. 1433, in the time of *Crishna-rayer*. A merchant gave some land for the service of the fane.

51. Dated in Sal. Sac. 1446, in the time of *Crishna-rayer*: his general gave some land for the use of the attendants on the shrine.

52. Dated in Sal. Sac. 1590. Gift by *Mutta Raman* of money, and rice-grain, for the festival services.

53. Dated in Sal. Sac. 1445. Gift of land by *Appaiyan*.

54. Dated in the time of *Achyuta-rayer* in S. S. 1452. Gift of money by two or three persons, whose names are mentioned.

55. Dated in Sal. Sac. 1496, in the time of *Vera-pratapa-dever-maha-rayer*. Gift of a village, including wet and dry lands, the produce to supply food to the servants, or attendants, of the fane.

56. Gift of two villages by *Anna-muttamal*, a lady so named. No date of year.

57. Dated in S. S. 1459, in the time of *Achyuta-dever-rayer*. Gift by *Roma Pattar* of *Uriyur* village; for the celebration of festival processions.

58. Dated in Sal. Sac. 1602. Gift of some lands made over to managers of the fane; name of the donor does not appear.

59. Dated in Sal. Sac. 1473, in the reign of *Sada-Siva*. Gift of *Chola-nallur* village, and 109 pieces of money, to supply food for the fane.

60. Dated in the time of *Tribhuvana Chacraverti-Rajendra-Chola-dever*, 7th year of reign: gift of a flower garden to supply flowers for the image by *Narasingha-Nayak*.

61. Dated in Sal. Sac. 1596. Gift of money, for the service of the fane, by some head-men.

62. Dated in Sal. Sac. 1588. Gift of four hundred *huns* by an annual impost on a village to supply butter-oil, for the lamps, and for festivals.

63. Dated in Sal. Sac. 1591. Gift of two villages by *Alagiriyan* to the fane.

64. Dated in Sal. Sac. 1593. Gift by *Basavapa-nayak* of some lands, for the service of the idol.

65. Dated in Sal. Sac. 1613. Some regulations as to the order first, second, third, and so on, in which certain *Brahmans* were to put garlands on the idol, at the time of public processions.

66. Dated in Sal. Sac. 1588. Gift by sixty head-men, of land for the support of *Brahman* families, in an *agrahâram.*

67. Dated in Sal. Sac. 1596. *Choka-nat'ha-nayaker* gave a village; the proceeds to supply food to *Brahmans.*

68. An inscription commemorating the self immolation of a manager of the fane at *Sri-rangham* (near Trichinopoly) whose name was *Appana-ayengar.* In consequence of all supplies to the fane being withheld, in a bad time, he ascended the *Rayer-gopura* or lofty tower, and precipitated himself to the ground. The 24th of *Tai* of a cycle year only is mentioned. The precise time of this occurrence cannot be, from the document, ascertained. But possibly it is the incident related by Mr. Orme; and by him ascribed to a somewhat different cause.

69. Dated in Sal. Sac. 1596. Gift of a village by *Chola-nât'ha-nayaker* of the line of *Visvanât'ha-nayaker*, for the supply of food, and for expenses of festival processions.

70. Dated in Sal. Sac. 1172, relative to the fane of *Cholesvara-svami* in the district of *Dharapur-tuccadi.* Gift of a village; by whom does not appear.

71. In Coimbatore. Gift of six elephants, to what place is not specified.

72. Inscription dated in Sal. Sac. 1449. Gift of a village, by whom does not appear. The gift is to a *Vaishnava* fane.

73. In *Dharapuram* district. Inscription, commemorating the gift of a village.

74. Dated in Sal. Sac. 1262, in the time of *Vallâlan-dever.* Gift of a village, the reservoir to supply water for washing the image.

75. Dated in Sal. Sac. 1501. Gift of a certain portion of land; the proceeds to supply sacrifices and offerings.

76. Gift of a village, by two persons mentioned, to a fane of *Vara-da-raja.*

77. Inscription, publishing charitable grants at the *Vaishnava* fane of *Mascà*, in the hundred of *Cerunturai* in Coimbatore.

78. At *Dondesvara* fane, in the same district. A record of charitable donations.

79. Gift to Brahmans at *Satyavedamangalam* in the *Cali-yuga* year 1607½ (more probably Sal. Sac. 1607).

80. Dated in *Cali-yuga* 4432. What was given not legible.

81. Dated in the 3d year of *Vira-raja-devan*: the letters of the inscription could not be copied.

82. Dated in Cali-yuga 4632, in the government of *Pilla-rája;* gift of a village, to a fane.

83. Inscription at *Agastes-vara* fane in *Dharapuram.* Dated in *Cali-yuga* 4633, in the time of *Deva-maha-raja.* Gift of cows, and other cattle, by a trader.

84. Dated in Sal. Sac. 1621. Gift of 3 reservoirs, a grove, and fertile land, during the power of *Chitambara-nát'ha-Muthali.*

85. Dated in Sal. Sal. 1421. Gift of land.

86. Dated in Sal. Sac. 1333. Gift of a village, and of a house, for the maintenance of a daily rite of homage.

87. In the time of the *Vallála* king. Gift of a water reservoir.

88. Dated in the 5th year of *Vicrama Chola-dever.* Gift of a garden, well and cows, for the use of a fane.

89. Dated in *Tribhuvana Chacraverti's* reign. Gift of some coins, current at that time.

90. Gift of food for the servants or attendants of a fane by the head-men of a village.

91. A similar donation.

[It appears to me profitless, and uninteresting, to continue so minute a detail, the whole has been carefully examined; but in what follows that only which seems to be a little more special is given].

92. In the time of *Achyuta-rayer* Sal. Sac. 1200: a gift of land.

93. A tabular list of inscriptions; with the date; year of kings' reign; or other distinctive mark; which may be of use to refer to: the number is but small.

94. A paper referring to some modern affairs, in the wars of the south; the names of English officers occurring.

95. A few dates which refer to later periods of rule, than Sal. Sac. 1600.

REMARK.—The *materiel* of this book was observed to be in a rapidly perishing condition; and restoration by a copyist was necessary in order to ascertain the value of the contents. This may be judged of from what goes before. My own estimate would be but moderate; though there certainly are dates, and names, that are of use in confirming or correcting other written documents. The book itself will not long continue legible; but the restored copy can be referred to, should occasion so require.

(To be continued.)

VIII.—*Remarks upon Colonel* REID'S "*Attempt to develop the Law of Storms.*"*—By T. G. TAYLOR, ESQ. Astronomer to the Honourable East India Company.

The author commences by stating, that his attention was first directed to study the subject of storms, when employed at Barbadoes in rebuilding the Government offices which had been blown down in the hurricane of 1831; when "1477 persons lost their lives in the short space of seven hours." Pursuing the subject, Col. REID has collected from various sources, a large connected mass of information; from which it would appear—that the character and disposition of the larger gales of wind, or hurricanes, are not of that casual order that they have generally been supposed to be.

We may mention, that Col. REID has not exactly proposed a new theory, but in the end, has rather instituted an inquiry into—how far the whole of the facts relative to hurricanes (derived principally from the logs of different ships) may be explained *by a* theory.

Col. CAPPER, as far back as 1801, had mentioned in his history of storms upon the Coromandel Coast, that "it would not, perhaps, be a matter of great difficulty, to ascertain the situation of a ship in a whirlwind, by observing the strength and changes of the wind. If the changes are sudden, and the wind violent, in all probability the ship must be near the centre of the vortex of the whirlwind; whereas if the wind blows a great length of time from the same point, and the changes are gradual, it

* *An Attempt to develop the Law of Storms by means of facts, arranged according to place and time; and hence to point out a cause for the Variable Winds, with the view to practical use in Navigation. Illustrated by charts and wood cuts.—By Lieutenant-Colonel* REID, C. B. *(of the Royal Engineers), London,* 1838.

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NATURAL HISTORY

Fig. 1.

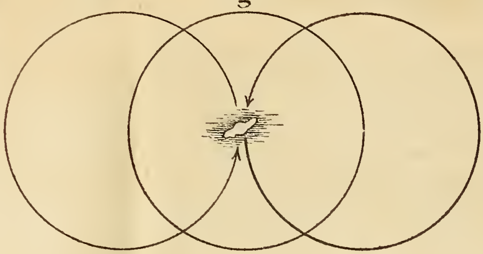


Fig 3.

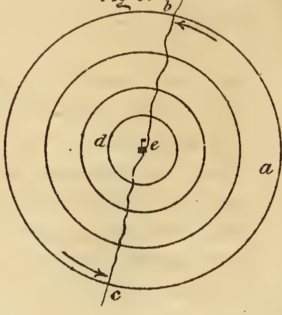


Fig. 2.

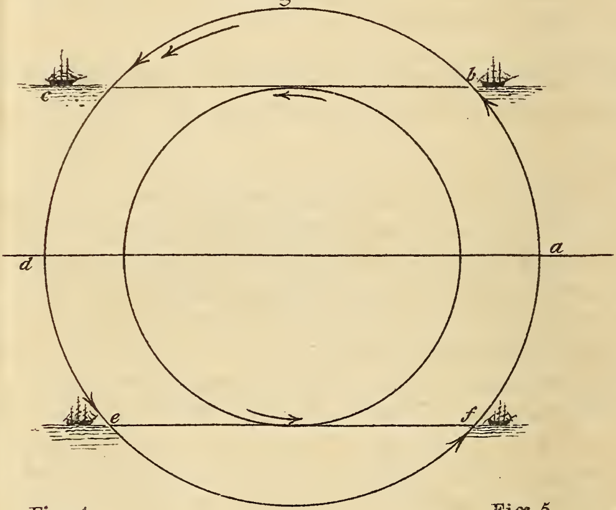


Fig. 4.

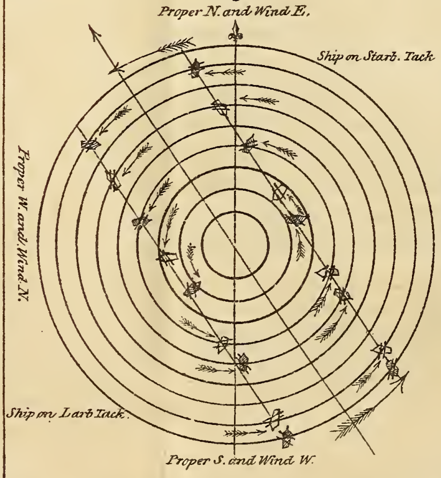
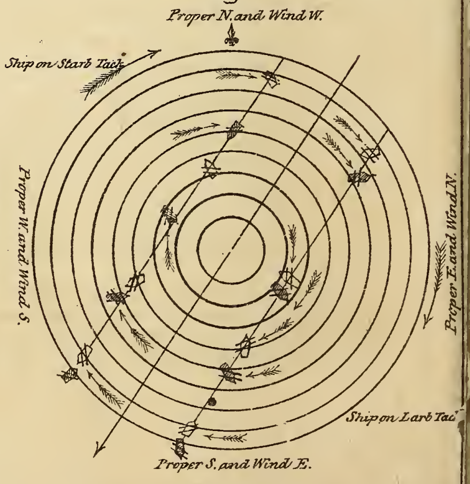


Fig. 5.



may be reasonably supposed the ship is near the extremity of it."* These views too had likewise been entertained by Mr. W. C. Redfield of New York, from a consideration of the storms occurring in the West Indies. On laying down on a chart the position of ships situated at various places within the ranges of several of these storms, Col. Reid found, that "*the more exactly this was done, the nearer appeared to be the approximation to the tracks of a progressive whirlwind.*"

To understand the effect of a progressive whirlwind, it is only necessary to inspect the figures 1, 2, and 3, Pl. 8. In figure 1, the Island, with reference to the circle to the right, would experience a *northerly* gale; and, supposing the storm—the whirlwind—to be travelling towards the left, or due west, the northerly gale would continue, until, by its progressive motion, the island were situated in the centre of the circle, when a calm might be expected; after which, the gale would assuredly set in from the directly opposite quarter (from *the south*); until, having arrived at the position occupied by the circle to the left, the storm would here cease.

If, instead of an island, we consider the case of a ship under sail, the circumstances might be considerably altered; for, were the ship's course the same as that pursued by the storm, it might, by keeping pace with the storm, continue for days within its influence; whereas, by an opposite course, it would in a comparatively short time be got rid of. If the ship were situated at *c*, as in fig. 2: supposing the direction of the whirlwind to follow the course *a b c d*, then, the wind at the commencement of the gale would set in from the N. E.; after which it would shift to the east, and terminate eventually at S. E.: but, were the ship situated in the lower portion of the circle (at *e*), then the wind would set in from the N. W., after which it would shift to the west, and eventually terminate at S. W. If, however, the whirlwind were to follow the direction *d c b a;* the direction of the wind, both at the commencement and end of the storm, would be different: for the upper position (*c*), the wind would in this case commence at S. W.—shift to the west, and terminate at N. W.; and for the lower position in the figure (*e*), the wind would commence at S. E.—shift to the east, and terminate at N. E.

Hence it became a matter of some importance, to learn—if whirlwinds in the southern hemisphere revolved in the same direction as did those in the northern. The investigation was difficult, from the few observations which could be met with in the southern hemisphere; but, on the whole, it appeared that there was no exception to the general rule, *that the whirlwinds in the northern hemisphere all revolved after the order N. W. S. E. (according to the order of the signs); whereas those in the*

* Reid, p. 2.

southern hemisphere all revolved in the opposite direction, or N. E. S. W. (contrary to the order of the signs).

If we could now discover, that the tracks of storms in various parts of he globe, followed fixed laws; for instance—that the tracks of storms on the Coromandel Coast travelled from east to west *always*,—that the Mauritius storms pursued a south westerly course; and that the storms peculiar to the West Indies originated from the east, and, recurving parallel to the coast of America, terminated in a westerly course;—could we be sure that these laws were *always* observed by storms, we should be then in possession of facts, sufficient to enable us to sail in a direction at the commencement of a storm, so as to avoid encountering its worst effects. With regard to the rate of progression of storms, it appears that they are various; being, in some cases, as low as seven miles per hour; whilst others there are, whose velocity has reached forty or fifty miles per hour.

In Col. Reid's work, the tracks of nine storms which have occurred in the West Indies are laid down in a chart. In each of these the course of the several storms has been accurately traced to be from W. by N. to W. N. W., when encountered within the limits of 10—20 degrees of north latitude; after which, gradually curving towards the north, in the 30th degree of N. lat, its course becomes due north: from thence—apparently with perfect symmetry—the curves incline towards the east.

The East Indian gales appear invariably to travel from the coast of Arracan:* towards the west; the curves conforming gradually to the slope of the shore, until in about the latitude of Madras, when their course is due south; after which the curve bends again towards the west, the violence of the storm seldom extending below Cuddalore, or Porto Novo.

The Mauritius and Madagascar storms appear likewise to travel from the eastward at their commencement; but the point of recurving, from want of sufficient observation, does not appear yet to have been clearly made out.—We meet with the following description of the hurricane at the Mauritius in 1818.

" La salle de spectacle est un très-grand édifice. Sa forme est celle
" d'un T dont la tête est un avant-corps considérable, puisque la partie
" postérieure, formant la queue du T, a seule 53 pieds de largeur sur 82 de long. Si cet édifice eût été brisé par la tempête on aurait pu attribue

* The progress of the Madras storms has not yet been correctly ascertained:—the storm of 1836 appeared to come from the eastward direct, but the matter is very doubtful.

" cet événement á la manière dont il était construit; mais, ce qui est à-
" peine croyable, cet immense arrière-corps de 34 pieds et surmonté d'un
" comble en charpente, lié en outre avec l'avant-corps qui forme la
" façade, a cependant chassé de près de cinq pieds sur son soubassement.
" Quelle force prodigieuse que celle qui a pu produire, le déplacement
" horizontal d'une telle masse! son renversement eut été un phéno-
" mène ordinaire; sa translation, si l'on peut employer ce terme, ne se
" conçoit pas."*

In the concluding chapter, we find as follows.

" It is a well known fact, that some parts of the globe are more subject
" to storms than others; and I have throughout this investigation felt
" impressed with the opinion, that the force and frequency of storms
" may have some connexion with the law of magnetic intensity.

" The islands of Mauritius and St. Helena are nearly in the same de-
" gree of south latitude; yet at St. Helena a gale was scarcely ever
" known, and it is said to be entirely free from actual storms. Those
" who study Major Sabine's report on the magnetic intensities of the
" globe, and follow his isodynamic lines which express unity, will find
" them opening from each other in the northern part of the south Atlan-
" tic, and including a space which thus really appears to be the true
" Pacific Ocean of the world. Within this space, on Major Sabine's
" charts, will be found two other lines, marking intensities in decimal
" parts less than unity; and he states that the intensity at St. Helena
" as observed by Captain Fitz Roy, is 0, 84: the lowest denomination
" recorded, and the locality of the weakest intensity yet observed on the
" globe.

" When we examine the lines of the greatest intensity, we find them
" 'approaching each other in longitude 110° and 260°' (100° W.), but
" in different latitudes; for the line of least intensity does not coincide
" with the earth's equator. In the Chinese sea, in longitude 110° E.,
" it is to the north of the equator, proceeding thence in a direction south-
" ward of St. Helena.

" Of the supposed four magnetic poles, the positions of the two in the
" northern hemisphere are the best ascertained. The meridians which
" run through these two poles, run also through the Chinese sea and
" near the Caribbean sea, the localities of typhoons and hurricanes; and
" Major Sabine's isodynamic lines indicate the magnetic intensities so
" strongly marked there, that we are led to the belief that there must be
" some connexion between the magnetic intensity and the force of
" storm."†

* Reid, p. 141. † *Ibid.* p. 415.

The above contains the spirit of pretty nearly all the subjects adverted to in Col. Reid's work. Among the rest, there are suggestions for registering the state of the barometer at the several light-houses at places on this side of the Cape, and for collecting information from the logs of ships which have encountered bad weather, &c. Account of water-spouts—whirlwinds, &c. In furtherance of these wishes I will here mention one objection—which, although not disproving the theory that storms arise from rotatory and progressive whirlwinds—still renders necessary some explanation beyond that of rotation and progression. In England, for several years I had been in the daily habit of noting the indications of the barometer, and on the occurrence of gales of wind, my attention was very particular. I have no memoranda by me at this moment to offer in evidence, but I may mention, that I had invariably noticed—*that the rate at which the barometer rose after gales had reached their climax, was always much more rapid than that it had observed in falling previously thereto;* and, on consulting the observations made at Madras and other places, the same circumstance I find *always* occurs. Thus, during the gale of wind at Madras in 1797, we have the following recorded observation :—

Date.	Barometer inches.	Hourly var.	Wind.	Remarks.
Oct. 25th at noon	30.005	.011	——	Gale of wind.
27th — 2 P. M.	29.465		——	Do. at height.
28th — 6 A. M.	29.819	.022	——	Do. had subsided.

In the gale of wind at Madras in October 1818 :—

Oct. 23d at 8 P. M.	29.80	....	N.	Very high wind.
24th — 5 A. M.	29.50	.131	N.	A violent gale.
24th — 10½ A.M.	28.78		calm	An awful lull.
24th — 12 A.M.	29.28	.333	S.	Hurricane at 11 h.

In the gale of wind at Madras in May 1820 :—

Oct. 8th at 10 A.M.	29.750	....	N.W.	Very strong wind.
8th — 8 P. M.	———	....	N.W.	Strong gale.
9th — 6 A.M.	29.400	....		Gale increasing.
9th — 12 A.M.	29.135	.106	W.	Ditto.
9th — 3 P. M.	28.816		——	Still stronger.
9th — 5 P. M.	28.670	.073	——	Continues.
9th — 9 P. M.	28.5*	.126	S.W.	Gale at its height.
10th — 6 A.M.	29.633		——	Moderate weather.

* This is assumed with reference to the two previous observations, but it appears that no actual observation of the barometer was made at this moment.

In the gale of wind at Madras in October 1836:—

30th at 12 A. M.	29.707	....	N.	Approaching a gale.
30th — 1 P. M.	.586	....	N.	Brisk gale.
30th — 2 ——	.321	....	N.	Do. do. [gale.
30th — 3 ——	.269	....	N.	At times a violent
.... — 4 ——	.111	....	N.	Very violent gale.
.... — 5 ——	28.891	.266	N.	Approaching to a [hurricane.
.... — 6 ——	.625	.340	N.	Do. do.
.... — 7 ——	.285			
.... — 7-45 m. —	.285	.550	N.	Approaching a calm.
.... — 8-30 m. —	.725	.302	calm	From 7.15 to 7.45 an awful lull.
.... — 9 ——	29.027		S.	A furious hurricane.
... — 10 ——	.258	....	—	A strong gale.
.... — 11 ——	.415	....	—	Very strong wind.

In Colonel Reid's book there are given several registeries of the barometer during storms, but these having been made on board of ships (which probably occupied different places at the different times of observations) are not available for our present purpose. There is, however, one hurricane (which occurred in March 1836 at the Mauritius), in which the barometer was not only registered on shore, but that too, with more than ordinary care:* thus—

Mean Time.	Barometer inches.	Hourly var.	Direction of wind	Remarks.
March 6 at 6 A. M.	29.220	.050	from S. to E.	Strong and sudden gusts.
...... — 8 ——	.120	.137	E.N.E. to S.W. by W.	
...... — 10 ——	28.845	.150	Do. to Do.	
...... — 12 ——	28.545	.107	Do. to Do.	
...... — 2 P. M.	28.330	.037	N. E. to S. W.	
...... — 4 ——	28.255		S. by W. moderate.	
...... — 5½ ——	28.235		........................calm.	
...... — 7 ——	28.275	.145		
...... — 8 ——	28.420			

Varying with the barometer, is likewise the intensity of the storm, as will be seen with reference to the above five cases, thus—

Storm observed at			Interval begin. and mid. D. H.	between the mid. and end. D. H.
Madras	in	1797	.... 2. 2	.... 0.16
———	—	1818	.... 0. 5	.... 0. 2
———	—	1820	.... 1.11	.... 0. 9
———	—	1836	.... 0.10	.... 0. 4 or 5
Mauritius	—	1836	.... 0.22	.... 0.11 Doubtful.

* Reid p. 155.

Now the continued occurrence of phenomena of this nature, militates against the theory, "that storms are progressive whirlwinds," or rather —as I have observed before—leaves the theory incomplete: for, we should naturally expect from a whirlwind, that its sectional outline would be circular, and, that the time occupied between the commencement and middle, would correspond with that observed between the middle and termination, whereas we have just found them to stand in the proportion of 2½ to 1. In other respects too, the theory adopted by Colonel Reid has not met with complete confirmation, as will be seen with reference to particulars observed in the Madras storm of 1836: it appears from the little information I was then able to obtain, that the centre of this storm passed over a ship (the Water Witch), at a distance of 780 miles to the eastward of Madras, at ½ past 7 o'clock on the evening of the 29th October—just 24 hours before it reached Madras; exhibiting a velocity of progression of 32 miles per hour: hence, whatever may have been the rotatory velocity of any point such as *a* fig. 3 (call it *x*), it follows, that, at some place (*b*) to the northward of Madras, a hurricane of the velocity $x + 32$ miles per hour must have been experienced; whereas at a corresponding place (*c*) to the southward, a velocity $x - 32$ miles per hour only would have been experienced; or, since *x* represents the velocity which would be experienced at Madras, it would appear, that the gale must have been 64 miles per hour more rapid—stronger—to the northward of Madras than it was to the southward: whereas, from enquiries made at the time, it appeared that a trifling difference only was experienced. With this view of the subject, it will, perhaps, eventually be found necessary to admit, that the onward progression of storms is propagated by *undulations*, and not by an actual movement of the particles composing the whirlwind:—and, further, with reference to fig. 3—if the smaller circle *d e*, represent the space within which the air was quiescent, the theory would lead us to suppose that at *d* and *e* a similar strength of wind would be experienced; whereas, in the storm of 1836, as well as that of 1813, and indeed in every storm which has occurred at Madras, the wind experienced after the lull, is far more violent than that which preceded it.

In conclusion, I may say for myself, that I have been led to make these remarks, not with a view of finding fault with Colonel Reid's book or his theory, but with an earnest desire of forwarding, to the best of my abilities, what he has so ably commenced.

Madras Observatory:
1*st June*, 1839.

[We have been induced to make the three following extracts from Colonel Reid's book, as a supplement to Mr. Taylor's paper; the first, from the local interest it possesses, as exhibiting the fact that the first observation leading to the new theory was made by a distinguished Madras Officer, from what passed before his eyes here on our own coast; the second, as describing a phenomenon calling for elucidation, which may probably be rendered by some of our readers in the Straits, or by those who voyage thither; and the third, because it explains the useful practical results, which, it is hoped, may spring from the new theory.

Colonel Reid seems not to have been aware of the able meteorological observations made by Mr. Goldingham, late Astronomer of Madras, published in the *Appendix* to the 3d vol. of the *Transactions of the Royal Asiatic Society* and republished in this Journal, No. 12, p. 157.—Editor.]

Colonel Capper's Whirlwinds.—The late Colonel James Capper's opinion, that hurricanes are vast whirlwinds, was formed during twenty years' observation and study of the subject, on the coast of Coromandel. In the preface to his work, published in 1801, he says, that when he first attempted an investigation into the winds in India he had great doubts of success, from the number and variety of them: but as he proceeded, he found that there were many words to express the same thing, and that the hurricane, the typhoon, and the tornado, were but English, Greek, or Persian, and Italian or Spanish names, for a whirlwind.

In classing the winds, he observes, "the tempest is, both in cause and effect, the same as the hurricane or whirlwind; and that the storm, or what the Englishman calls a hard gale, is likewise nearly the same." He also states, that it is a long standing error that hurricanes in India occur only at the changes of the monsoons; and that Dr. Halley must have been misinformed on that subject.

There is this difference in the observations of Colonel Capper and Mr. Redfield, that the former seemed of opinion that all whirlwinds are local and temporary, whilst Mr. Redfield has clearly shown that they are progressive. It is not improbable, however, that some storms are local, and end nearly at the same place where they began.

The accounts of those storms, quoted by Colonel Capper, extracted from Orme's History, all occurred on the coast of Coromandel: but the reports given of the winds, though they show that these hurricanes were whirlwinds, are not sufficiently detailed to enable us to determine their tracks, and from what directions (if they were not local) they came.

The following are extracts from Colonel Capper's work on the winds and monsoons.

"During the siege of Pondicherry, at the time of the N. E. monsoon and on the 30th of December, 1760, the weather was fine in the evening; but a heavy swell rolled on the shore from the south-east. The next morning the sky was of a dusky hue, accompanied by a closeness of the air; but without that wild irregularity which prognosticates a hurricane. Towards the evening, however, the wind freshened from the *north-west*, and at 8 at night increased considerably. About midnight the wind veered round to the *north-east*; fell calm, with a thick haze; and, in a few minutes, flew round to the *south-east*, whence it blew with great violence. Almost all the ships might have been saved, had they taken advantage of the wind blowing off the land: but the roaring of the wind and sea prevented the captains from hearing the signals for standing out to sea. The Newcastle and Protector were driven on shore, a few miles south of Pondicherry, and the crews were saved. The Norfolk, Admiral Stevens, returned next day; and on the 7th came in the Salisbury, from Trinco Trincomalee, south; and the Tiger from Madras, north: so that in these opposite directions, of east, north, and south, the violence of the storm had not been felt.*

"The next in succession was that of 1773; on the 20th of October that year, many days after the north-east monsoon had apparently commenced, the wind began to slacken, and the clouds in the evening appeared uncommonly red; particularly on the day preceding the storm. On the morning of the 21st, a strong wind blew off the land; and, in the course of a few hours, flew all round the compass. At this time the Norfolk, man of war, Admiral Cornish, with the America and Weymouth, and the Princess Charlotte, country ship of 400 tons, remained in Madras roads, with several other country vessels. The wind began to blow from the north-west, and continued from that quarter for three or four hours; of which time the men of war availed themselves to put to sea: but it then suddenly shifted to the *eastward*, and prevented most of the country ships from following their example. After having blown with incessant

* After this went to the Press, I obtained, from the Admiralty, copies of the log books of the Norfolk, the Salisbury, Tiger, York, and other ships of Admiral Stevens' squadron in 1760-1. The storm above alluded to began about N. N. W., and ended about S. S. E.

The Tiger, as well as the Salisbury, York, and Weymouth, were all to the *southward* of Pondicherry; and were, in different places, within the influence of this storm; apparently, showing that this storm came from the direction of the equator, as well as the others, although it must have moved a little southerly at Pondicherry, by the wind veering from N. N. W. to S. S. E.

violence for fourteen hours, and with almost equal strength from every point of the compass, it at length ceased; but literally left only wrecks behind.

"All the vessels at anchor were lost, and almost every person on board perished; but the men of war and Princess Charlotte returned into the roads on the 24th. The former had felt the gale very severely whilst near the coast; but without sustaining any material injury: the latter vessel likewise, from staying rather too long at anchor, had lost her fore and main masts, and was otherwise much damaged."

After accounts of other storms, Colonel Capper continues:—

"Ships which put to sea in due time, very soon get beyond the influence of the hurricane to the eastward; and it is very well known that they never extend far inland. All these circumstances, properly considered, clearly manifest the nature of these winds, or rather positively prove them to be whirlwinds, whose diameter cannot be more than 120 miles; and the vortex seems generally near Madras or Pulicat. Those which happen in the north-east monsoon, generally fall with most violence within a few leagues of this place, and never, I believe, reach south of Porto Novo.

"But at the commencement of the south-west monsoon, violent gales are sometimes felt on the east side of Ceylon, and the southern extremity of the coast."

After describing a hurricane, encountered in south latitude by the Britannia, Indiaman, on the 10th of March, 1770, and explaining that it did not extend above 30 leagues, since the Britannia fell in with two ships which were within this distance, Colonel Capper proceeds:—

"Thus then it appears, that these tempests or hurricanes are tornadoes or local whirlwinds, and are felt with at least equal violence on the sea coast and at some little distance out at sea. But there is a material difference in the situation of the sun when they appear at different places: on the coast of Coromandel, for example, they seldom happen, particularly to the northward, except when the sun is in the opposite hemisphere. On the Malabar coast they rage with most violence during the monsoon, whilst the sun is almost vertical. Near the island of Mauritius, they are felt in January, February, and March, which may be deemed their summer months; and in the West Indies, according to Mr. Edwards's 'History of Jamaica,' the hurricane season begins in August and ends in October."

In Colonel Capper's work, we find Franklin's explanation of what first led him to observe that the north-east storms of America came from

the south-west. It is in a letter to Mr. Alexander Small, dated the 12th of May, 1760, and is as follows:—

"About twenty years ago, we were to have an eclipse of the moon at Philadelphia, about 9 o'clock; I intended to have observed it, but was prevented by a north-east storm, which came on about 7, with thick clouds as usual, that quite obscured the whole hemisphere; yet when the post brought us the Boston newspaper, giving us an account of the same storm in those parts, I found the beginning of the eclipse had been well observed there, though Boston is north-east of Philadelphia about 400 miles. This puzzled me, because the storm began so soon with us as to prevent any observation; and, being a north-east storm, I imagined it must have begun rather sooner in places further to the north-eastward, than it did at Philadelphia; but I found that it did not begin with them until near 11 o'clock, so that they had a good observation of the eclipse. And upon compairing all the other accounts I received from the other colonies, of the time of the beginning of the same storm, and since that, of other storms of the same kind, I found the beginning to be always later the further noth-eastward."

Whilst introducing the above paragraph, Colonel Capper says, it affords us a proof that a current of air in America moved many hundred miles during a north-east storm, probably from the Gulf of Mexico to Boston. Thus, having stated his belief that hurricanes were whirlwinds, he was upon the point of showing also that they were progressive.*

Ripplings in the Straits of Malacca.—A disturbance of the surface of the sea of a different kind has been observed in the Straits of Malacca, which is not easily accounted for; and I shall here insert Horsburgh's description of it, in the hope that it may create inquiry and observation.

"In the entrance of Malacca Strait, near the Nicobar and Achen Islands, and betwixt them and Junkseylon, there are often very strong ripplings, particularly in the south-west monsoon; these are alarming to persons unacquainted with them, for the broken water makes a great noise when a ship is passing through the ripplings in the night. In most places, ripplings are thought to be produced by strong currents, but *here* they are frequently seen when there is no perceptible current. Although there is often no perceptible current experienced, so as to produce an error in the course and distance sailed, yet the surface of the water is impelled forward by some undiscovered cause. The rip-

* Reid, pp. 263-7.

plings are seen, in calm weather, approaching from a distance, and in the night their noise is heard a considerable time before they come near; they beat against the sides of a ship with great violence, and pass on, the spray sometimes coming on deck; and a small boat could not always resist the turbulence of these remarkable ripplings."

Naval officers, who have often seen these ripplings, represent them as being met with out of soundings, and in other localities besides the Straits of Malacca. They are supposed to be circular in form, and of various diameters, from a few hundred yards to a mile. The ripples are obliterated by strong winds, which raise waves on the surface of the sea; but they are distinguished from other undulations by a breeze, which has carried a ship two knots an hour with sky-sails set. If two ships in company meet these ripplings, they might, by heaving-to on opposite sides of the disturbed portion of the sea, observe if there were any circular current. If water-spouts are electrical phenomena, and if the Orontes was carried forward by such a cause, the same cause might give motion to the sea in the manner described, and might agitate its surface.

The great height to which the salt water of the sea is sometimes carried up into the air, whether by the mere force of the wind driving it as spray, or by some lifting motion, as in the water-spouts, deserves attention. That which follows is an extract from the April report from Barra Light-house for the present year (1838), sent me by Mr. Robert Stevenson, the engineer to the northern light-houses.

"On the 16th it rained spray and snow all day; so that for a week after we had no fresh water on the island." And Mr. Stevenson added this note to the report:—"The top of the island, or base of the light-house, is 600 feet above the level of the sea."

It had blown a storm, and the height of the barometer was, according to the same report, as follows:—

April, 1838.	Barometer.	Wind.
Saturday 14	9 A. M. 29.30	S. W. & W. breeze.
	9 P. M. 28 93	
Sunday 15	9 A. M. 28.80	N. W.
	9 P. M. 28.93	Ditto.
Monday 16	9 A. M. 28.94	Ditto.
	9 P. M. 28.96	Ditto.
Tuesday 17	A. M. 29.20	N. N. W.
	P. M. 29.34	North.

Rules for laying Ships to in Hurricanes.—That tack on which a ship should be laid-to in a hurricane, has hitherto been a problem to be solved; and is one which seamen have long considered important to have explained.

In these tempests, when a vessel is lying-to, and the wind veers by the ship's head, she is in danger of getting stern-way, even when no sail is set; for in a hurricane, the wind's force upon the masts and yards alone will produce this effect, should the wind veer a-head; and it is supposed that vessels have often foundered from this cause.

When the wind veers aft, as it is called, or by the stern, this danger is avoided; and a ship then *comes up* to the wind, instead of having to *break off* from it.

If great storms obey fixed laws, and the explanation given of them in this work be the true one, then the rule for laying a ship to, follows like the corollary to a problem already solved.

In order to define the two sides of a storm, that side will be here called the right-hand semicircle which is on the right of the storm's course, as we look in the direction in which it is moving; just as we speak of the right bank of a river.

The rule for laying a ship-to will be, when in the *right-hand* semicircle, to heave-to on the *starboard* tack; and when in the *left-hand* semicircle on the *larboard* tack, in both hemispheres.

Fig. 4, Plate 8, is intended to represent one of the West Indian hurricanes, moving towards the east-north-east, in the direction of the spear drawn obliquely. The commander of a ship can ascertain what part of a circular storm he is falling into, by observing how the wind begins to veer. Thus, in the figure, the ship which falls into the right-hand semicircle, would receive the wind at first about east by north; but it would soon veer to the east, as the storm passes onwards. The ship which falls into the left-hand semicircle, would at first receive the wind at north-east: but with this latter ship, instead of veering towards east, it would veer towards north.

The explanation of the rule will best be made out by attentively inspecting figures 4 and 5. In both, the black ships are on the proper tacks; the white ships being on the wrong ones.

Figure 5 is intended to represent one of those hurricanes in south latitude which pass near Mauritius proceeding to the south-westward. The whirlwind is supposed to be passing over the vessels in the

direction of the spear head. It will be seen that the black ships are always coming up, and the white ships always breaking off; and that they are on opposite tacks on opposite sides of the circles. Thus, the Astrea, commanded by the late Sir C. Schomberg, was on the proper tack on the 20th of March, 1811; and an inspection of the log of that ship shows how gradually she came up; but the Buccleuch, on the 22d of January, 1831, having had the wind from east-south-east, veering to south, and then to south-south-west, thereby proving her to be in the right-hand semicircle of a storm moving southerly, was in the wrong position when laid-to on the larboard tack. Had she been on the other tack, the wind in veering would have drawn aft; then, perhaps, she would not have lain so long "with her broadside in the trough of the sea, and with her lee-waist full of water."

If hurricanes were to move in the opposite course to that which they have hitherto been found to follow, then would the rule be reversed; for the white ships would come up, and the black ships break off.

It can require no comments to point out, that if the wind in storms follows a fixed law, much advantage may be gained by the knowledge of that law.

In following the tracks of storms here detailed, we find that the hurricane drawn on Chart VI. passed over the Island of Antigua in six hours. Yet the ship Judith and Esther, not far from that island, was twenty-four hours in the same storm; for that ship ran along with it; and many other instances of the same nature occur in this inquiry.

If one side of a storm be to a ship in her voyage a foul wind, the opposite side of the same storm would be a fair one. Thus, within the tropics in the Indian Ocean, the left-hand semicircle is a fair wind for ships in their voyages from India to the Cape of Good Hope, whilst the right-hand side will assist the voyages of outward bound ships: but there is this important difference, that in the first case ships would carry the fair wind with them; whereas in the other semicircle, owing to the ship sailing in the contrary direction to the progression of the gale, she would have the benefit of it during a short time only. Thus, if a hurricane coming from the eastward were passing over Mauritius, moving at the rate of ten miles an hour, and a ship sailing eastward were to fall into the side of the storm next the equator, the ship and storm would pass each other in half the time in which the hurricane would pass over the island, since they would be travelling at the same rates, but in opposite directions.

In the 12th edition of the 'American Coast Pilot,' will be found some practical rules, by Mr. Redfield, applicable to ships meeting storms in the North Atlantic, and all I have collected proves that these rules are correct. That a seaman may be able to apply them, however, requires that he should study the subject and understand the principle.

When storms recurve in either hemisphere, and cross the tracks of ships, the practical application of such knowledge as we have gained becomes more complicated. This will frequently happen to ships on their homeward voyage from India, and as they cross the meridians of the islands of Mauritius and Bourbon, about the 25th degree of south latitude. This may be a reason why the neighbourhood of these islands is so much dreaded; for the Mauritius hurricanes, instead of originating there, appear to come from the eastward.

If two ships, one in each hemisphere, were sailing west, and each met storms after they had recurved, the centres of both of which storms were also on the same parallels of latitude as the ships, the vessel in north latitude would meet the wind at south, and that in south latitude would meet the wind at north. Each ship would be most likely to avoid the storm by putting her head towards the equator: but they would be on opposite tacks. The ship in north latitude would be on the starboard tack, the ship in south latitude on the larboard. In both cases the wind would veer towards west, and both ships would come up until the storms passed by them, in their progress towards their proper poles; after which the wind might be variable.

The storm tracks here traced are far from sufficient in number to afford that knowledge of the winds, at which we are now capable of arriving. My object has been to prove, that the subject deserves the attention of abler men than myself, and that we have hitherto studied meteorology in far too confined a sphere. Since our own country is too limited for the comparisons required, nations should combine to study the atmospheric laws. The light-houses along the coasts of the civilized world might exchange their observations for this end. The great steam navigation companies might place their log-books where easy reference could be made to them; and, in the Pacific Ocean, many useful observations be made by the large body of Englishmen settled there as missionaries. A more perfect knowledge of the subject would improve international communication, which it is to be hoped for the benefit of mankind.*

* Reid, pp. 423-31.

IX.—*Special Report on the Statistics of the Four Collectorates of Dukhun, under the British Government.*

(Concluded from our last.)

Irrigation.

Preliminary to speaking of agriculture, it is necessary to state that lands are watered artificially in two ways. First, by conducting streamlets from running rivers or brooks. Lands so watered are called Paatsthul, from Paat, a channel, and Sthul, a field.* These streamlets do not always last through the hot season; and though this species of irrigation, while available, is infinitely less onerous and less expensive to the cultivator, affording also a more plentiful supply of water than the well watering and great returns; yet it is not so certain, and, on the whole, is less permanently efficient than well watering. The second method is by well watering. Lands so watered are called Moht Sthul, from Moht, the water-bucket, and Sthul, a field. There is a good deal of trouble attending this method, and it requires the continual expense of the support of two or four bullocks, the wear and tear of materials, and the keep of one man, who, however, can readily manage two buckets, and two pairs of bullocks: at the same time it requires also a boy in the garden or field to open and shut the different channels. This is the most common method of irrigation in the districts reported on. Usually only two bullocks are attached to each bucket; in some instances, however, where the wells are deep, four bullocks are attached to each bucket. The cattle pull down an inclined plane and discharge the water, and readily walk backwards up the plane to the highest part of it; on the bucket being refilled, they go down the plane again; the driver sings to them and rides down on the rope. The process is suspended for an hour or two during the middle of the day. A very considerable quantity of water is brought up by this method. The buckets in use vary little in size, and the wells, probably, range

* Literally "firm land."

from 25 to 45 feet deep: some experiments of mine, therefore, to ascertain the quantity of water brought up from a well 35 feet deep in a certain time, may be considered as an average of the efficiency of this method of irrigation. I found a moht (of six paahls) average a delivery of 198 wine bottles of water each time The bottle contained 28 ounces of water, apothecaries' measure, consequently the bucket contained 5514 ounces wine measure, 231 quarts, or 57 gallons 3 quarts. There is a singular uniformity of time between the delivery of two buckets, seldom exceeding seventy seconds: a man and a pair of bullocks, therefore, in an hour deliver 2931 gallons of water; and, labouring seven hours a day, give 20,517 gallons wine measure; and the same man with two pairs of bullocks delivers 41,034 gallons of water; a quantity infinitely exceeding what Europeans usually believe to be drawn up by the simple means employed. At eight pounds troy to the gallon, the weight of water drawn up by one pair of bullocks in one day will be 164.136-lbs. troy; and by two pairs of bullocks, 328,272-lbs. troy. This account appears very considerable, but my experiments have been repeated with care: and, on the whole, the delivery of water may be rather underrated than overrated.

Near the village of Piroorgoot, I observed a simple method of watering a field. The bed of a nullah, or rivulet, with very low banks, had been dammed up; three pieces of wood, like a gin, were put over the water; a scoop was suspended by a rope to the apex of the gin, and a man scooped out the water into his field. The labour was great, and the supply of water small. This apparatus is called Dohl.

It would appear to be of considerable importance to encourage the making of wells, as the only means of increasing the very limited exports of the Dukhun.

Agriculture.

Some general observations will be necessary, as the crops and agricultural process in the Mawuls* differ materially from the crops and agricultural process in the Desh.† The principal crop of the Mawuls is that of the rains, and the most valuable of its produce is rice. The severe labour attending the preparation of the rice ground in the hot weather is great, and in the rains the cultivator has to trample up to his knees in water and mud ploughing the rice field, probably in a deluge of rain, but

* Hilly districts along the crest of the Ghàts.

† Flat country, eastward of the Mawuls.

with his head and back most securely protected by the Eerluh,* however much exposed the rest of his body may be. The transplantation is performed under similar exposure. The other monsoon grains of the Mawuls are the Sawa, Wuree, and Natchnee, and Karlee, or Kalee Teel† which is an oil plant of the only other monsoon product.

The labour attending the cultivation of these grains, in a very unfavourable climate, at the time they are grown, falls very severely on the people, but they are compensated for their labour and suffering by good returns of that valuable produce rice; and the returns of the other grains are great, and the crops seldom fail.

The Koonbees, or farmers of the Mawuls, also have an advantage which those of the Desh are not always assured of, i. e. the certainty of finding a market for one of their products, rice.

Dry Season Crop (Mawuls).—The dry crop of the Mawuls does not call for any mention in this place.

Dry Season Crop (Desh).—With respect to the Desh, the most valuable is the Rubbée, or *spring* crop‡. The agricultural processes in both crops is certainly defective, less owing to the ignorance of the cultivators, who are well aware of the advantage of a ploughing adapted to the character of the soil, of good manuring, complete weeding, rotations of crops and fallows; than to their necessities, which compel them to rack their land; they cannot generally afford to purchase a sufficiency of manure, they have not any stable-yards, and the dearth of fuel compels them to burn much of their cow-dung; and, with a singular fatuity and injurious caution, they sow half a dozen grains and pulses together in the same field, which necessarily impede the growth of each other, exhaust the soil, and give limited returns. The professed object is to assure, in the occasional uncertainty of the monsoons, some kind of return at least for their labours, which might have been wholly unproductive had one grain only been sown. In short they want to have half a dozen strings to their bow instead of one.

Wet Crop (Desh).—The grains so sown ripen in succession, and two of them remain on the ground between nine and ten months; that is to say, from the beginning of June to the end of February. In their management of the plough, the Koonbees do not want dexterity. Their cattle have all names, know their names, and are obedient to them; with four bullocks to a plough, the leaders are guided entirely by the

* Eerluh, or basket-work hood, covered with leaves and quite impervious to rain.

† Wet season crop (Mawuls).

‡ Consisting of wheats, gram, barley; Shaloo, (*Andropogon Saccharatum*); Dhal, (*Cytisus cajan*), oil-plants, &c.

voice, and I have frequently seen quite a youth managing alone very cleverly his plough and four bullocks.

In the Desh, in manuring land, the cart called *Jang* or *Janj-eea,* is used; it consists simply of the common cart with a quite flat basket tied on the top of it, made by the Koonbees from the twigs of the Neergoondee, (*Vitex trifolia,*) or of the twigs of the Tooree, (*cytisus cajan*). The manure generally consists of the sweepings of their houses, which, from being usually cow-dunged every day and daily swept, are not trifling, and from the ashes also from their hearths.

Crops are carted to the *Kulleh,* or farm-yard, from the fields by the Garra. This consists of an upper horizontal rude frame-work supported on a thick axle-tree, and is removeable at pleasure. The wheels are of solid wood, small, placed under the frame-work, are not sufficiently far apart, and consequently subject the cart to upset, which is but too frequent an occurrence. Wooden pegs and thongs keep the whole vehicle together, and there is no more iron about the cart than the tire round the wheels and the hollow cylinders within the naves. This vehicle, considering the circumstances of the Koonbees, is expensive, costing from eighty to one hundred rupees, and it is only the most substantial among them who have carts. Having carted their grain, the Koonbees remove it to the Kulleh, or farm-yard.

Farm-yard.—The grain is stacked round a spot in the open air in a corner of one of their fields. This spot is circular, and has been prepared by beating and cow-dunging; a pole, called *Tewrah,* is fixed in the centre of it. In the reedy grains the heads are broken off by women, and strewed round the pole* to the depth of 5 or 6 inches. In the ligneous pulses, the extreme twigs, bearing the legumes, are broken off and strewed round the pole; and in the herbaceous leguminous pulses and straw-culm grains, the whole plant is put on the floor: six, or eight, or more bullocks (I saw sixteen at Munchur) are tied side by side, half on one side of the pole and half on the other; they are muzzled and driven round the pole, treading out the grain. This process usually occupies two men, and it is called the *Mullnee.* It is neither inefficient, nor dilatory. It would appear to be of great antiquity, and widely practised; in Deuteronomy, xxv. 4. we read, "Thou shalt not muzzle the ox when he treadeth out the corn."

Winnowing.—We are now brought to the winnowing the grain. This is done in the Kulleh; and when there are sufficient members in the family of the farmer after the first treading, the process is carried on simultaneously with the Mullnee. The process is very simple, but cer-

* Tewrah.

tainly not very efficient, as it is dependent on the wind blowing. In case the wind blows very hard, the grain is blown away; and in case the wind is not strong enough, the husks fall with the grain. A man stands upon a tall three-legged form, called the *Wawhree*, and pours the grain taken up from the treading ground, out of the winnowing basket (*oopunwutee*). The full grain falls perpendicularly and is pretty free from husks, but the lighter grain falls obliquely, and is partially mixed with the husks. A man sits at the base of the stool or form with a broom (*aatuee)* in his hand to assist in removing the chaff from the edges of the mass of fallen grain. After all is done, however, it is requisite to pass a good proportion of the grain through the sieve (*Chalun*). After the grain is winnowed it is carried home and laid in store.

Preserving Grain.—There are various ways of preserving the grain. Where the soil is sufficiently dry, chambers are dug in the earth for it; but the most usual plan in the districts is to preserve it in large baskets, called Kuneeng, made of twigs of the Neergoondee, (*Vitex trifolia*,) or of those of the Tooree, (*Cytisus cajan*). These baskets are plastered with cow-dung inside and out, and are perfectly impervious to rain or damp. Where the habitations are sufficiently large, or the baskets few in number, they are lodged in the house, but not unfrequently are placed outside of the house within reach of any pilfering hand. A few stones are put under each basket; the lid, in case it has a lid, is sealed down with cow-dung, and in case it has not a lid, a plaster of cow-dung a couple of inches thick is put over the grain; a little cap, or roof of grass, is put over the basket, and it is left exposed till required, being deemed equally protected from the elements and man. In the Mawuls, in the hot months, the whole of the grain baskets of the village, full of grain, may be seen assembled in front of the village, temple, and left to the custody of the village god. The roofs of all the houses are of grass in the Mawuls, and the dread of fires (the people having no chimneys to their houses) induces them to put their monsoon and winter stores in a place of safety, the extreme dryness of the period rendering accidents by fire frequent. It is not an unfrequent practice with the Koonbees of the Mawuls to unroof their houses for the months of April and May.

In addition to the baskets for the preservation of grain, earthen jars, called *Kothee*, made by the people themselves, are met with to hold grain, but they are not common.

Preparing Grain for Food.—The preparation of grain for food is the last process. Husk grains, such as rice, Wuree, (*Panicum miliare)*; and Sawa, (*Panicum frumentaceum)*; and the Johr, or husked wheat, require to be pounded to remove the husks. This process is entirely

within the province of the women: the implements used may be called the pestle and mortar; the mortar is called the ookul, and the pestle, moosul. The mortar in the Mawuls is frequently very rude in form, being a rough stone with a hole scooped in the middle of it to receive the grain. In the Desh, however, the mortar is of wood, of a good form, and sometimes carved. The *moosul*, or pestle, is always of wood, four or five feet long, tipped with iron, and in thickness and weight suitable to the strength of the person to use it. The final process is the grinding the corn; this also is the duty of the women, and two of them are usually employed at the mill. Christ says, " There shall be two women grinding at the mill;* one shall be taken and the other left."

Hand Mill.—The mill is portable, and is called Jatuh: it consists of two flat circular stones, fourteen or eighteen inches in diameter, placed one on the other; the lower one has an upright peg in it, the upper one has a hole in the centre through which the peg of the lower stone passes, and the upper stone is made to perform an horizontal rotatory motion round the peg by means of another upright peg near its margin. The grain is put in at the hole in the centre. This form of mill must be very ancient, for I saw remains of such mills in the ruins of Pompeii, and one nearly perfect in the ruins of the Roman villa of Sir William Hickes's estate near Cheltenham, Gloucestershire.

Raw Sugar Mill.—Under the head of agriculture it will be necessary to speak of the Gool, or raw sugar-mill. Sugar cane is not so much cultivated as it might be, and it is seldom found but at populous villages. I have seldom seen more than two mills at a village; and as the screws and accompaniments are somewhat expensive for the circumstances of a cultivator, the mills are seldom found belonging to him, but he is a renter of them for the term requisite. The mills are in the open air, and consist of two vertical screws which are sunk in a square chamber excavated in the earth; one of them is moved by a double lever so much elevated above the level of the field as to admit of bullocks being attached to the ends of the lever. The cattle go round incessantly in a circle and work the mill. The bits of sugar cane are passed twice between the screws, and the juice runs out into a wooden or copper vessel placed to receive it. The fire-place (Choolangun) and great iron pan (Kurhuee), to boil the juice in, are close at hand; a ladle to stir and skim the juice as it boils, and some circular holes in the ground to receive the juice when sufficiently thick, complete the material and close the process. The work is continued night and day till the cane-field is exhausted. Sugar is not refined in the Dukhun.

*Matth. xxiv. 41.

Oil Mills.—Although the oil mills belong to a class of persons who are not agriculturists, the Koonbee is quite dependent on them to turn his numerous oil seeds to account; some mention therefore of them is necessary under "agriculture." The body of the mill is generally of stone, and the machinery, even when of the rudest construction, shows a good deal of ingenuity and an acquaintance with some of the mechanic powers. It is entirely the work of the village carpenter.

At Neelsee, a Kohlee village in the wilds on the brink of the Ghàts, the body of the mill is of wood, the lever works in the hollow of an upright cylinder, and by the great weight attached to its upper end constantly presses against the sides of the hollow and forces the oil from the seed which is put into the mill. The whole expense of the machinery of this particular mill was only five rupees*. In the Desh the body of the mill is of stone, the machinery is the same as in this mill. It is worked by a bullock.

Average Size of Farms.—There are not any farms of large size under the management of a single farmer; the largest I recollect meeting with was about 200 acres, but in general they average very considerably less in size. In the Poona Collectorate the average size was 29 beegahs†, in Ahmednuggur 35 beegahs, in Dharwar $43\frac{6}{100}$ beegahs, and in Khandesh $23\frac{68}{100}$ beegahs. The average rent of a farm in Poona was less than 48 shillings per annum; in Ahmednuggur about 86 shillings; in Dharwar 64 shillings; and in Khandesh, where a good deal of the land cultivated is garden land, 74 shillings per annum. In Poona the average rent per beegah is within a fraction of two shillings; in Ahmednuggur about two shillings and six pence per beegah; in Dharwar not quite eighteen pence; and in Khandesh, where there is proportionably a good deal of garden land, it is somewhat more than three shillings a beegah. The average for the whole of the lands of Dukhun is two shillings and ninepence, one-eighth per *English acre*, or one rupee and fourteen reas per Dukhun beegah.

Proportion of Yoke Cattle to each Farmer.—Generally in the population returns there were great omissions of the draft or yoke cattle of the cultivators; no very satisfactory statement can therefore be given of their agricultural means in this kind of stock. In one Talook, or county of the Dharwar Collectorate, the yoke cattle were filled in, with the exception of two or three village returns, and the proportion is only 1·33 bullocks to each cultivator; but as the ploughs are 3733 in number in the Talook, at two bullocks to a plough, the proportion should be 2·89

* About ten shillings.

† The Dukhun beegah is three-fourths of an English acre. The rupee is valued at two shillings.

bullocks (nearly 3) to a cultivator: the returns must be defective, for I am satisfied, although a farmer may not have two bullocks to each of his ploughs, and he has generally a heavy plough and a light one, yet he has always two bullocks at least for one of his ploughs.

In the Ahmednuggur Collectorate the yoke cattle are not distinguished from the pack or carriage cattle, but the whole amount is very considerable, being 212,008. In the Poona Collectorate the returns give $2\frac{1}{4}$ yoke bullocks to each farmer, but the farmers near to the city of Poona are much better off, averaging $3\frac{1}{2}$ bullocks each. Only a portion of the returns from Khandesh had the column of draft or yoke cattle filled up: it is impossible, therefore, to give the proportion to each farmer for the whole collectorate; but as far as the returns went, it appeared that each farmer averaged only 1·62 bullocks, not quite $1\frac{3}{4}$.

Milch cattle.—The proportion of milch cattle, on which so much of the comfort of the people depends, whether rural or urban, in the Dharwar Collectorate, is greater than in the other collectorates, being one cow or milch buffalo to 2·45 souls. In Poona it is 1 to 5·24 persons: in Ahmednuggur 1 to 3·04 persons; and in Khandesh 1 cow or buffalo to 2·26 souls.

Ploughs.—As I have before stated, ploughs are of two kinds, the Nangur or heavy plough, and the Hulka Nangur or light plough; the same obtains with respect to drill ploughs, no grain being sown broadcast, the heavy drill plough being called Mogurb, and the light Pabhar. The proportion of ploughs in the Dharwar Collectorate is 1·41 to each cultivator, or nearly three ploughs to two farmers; the number of ploughs in the returns being 99,883, and the number of cultivators 70,488.

Carts.—Were a judgment to be formed of the state of the roads, and of the facility of communication and transit by wheel carriages, from the proportion of carts to the farmers, the estimate would be low indeed.* In the Dharwar Collectorate there is only one cart to thirteen farmers. The carts are universally of two wheels.

Pack Cattle.—The unusual number of pack bullocks, which carry loads on their backs, in the Dharwar Collectorate, would seem to indicate that they are the chief means by which agricultural and other produce is transported from place to place. In Khandesh there is the least number of pack cattle, and the greatest proportional number of carts. In Poona a great number of pack cattle, and only one cart to eleven farmers. The proportion in Ahmednuggur I do not know.

* It is nevertheless true, that had the farmers carts, they could rarely use them from the want of roads, unless in the dry season.

Land and other Tenures,

Lands are held under a great variety of tenures in Dukhun, some by virture of offices which are hereditary, some as hereditary freehold property, some in free gift from the state, some in Jagheer or military or feudal tenure, some on a quit rent, and in many other ways; but a rapid notice of the different tenures, and of the office-bearers holding lands, will best assist to give a clear idea of their quality and number.

In the first place, the proprietary right of the soil was (and is) in the people, and not in the sovereign. The sovereign could assess the land as he pleased, and assign away a part of the whole of the revenue arising from the land-tax or assessment, either in free gift (Eenam), military tenure (Jagheer), or quit rent, or in any other way; but he could not *justly* take away a man's land either for his own purposes or to give it to others; although, as a despotic prince, like all other princes of India, he had the undoubted *ability* to do so at his pleasure: yet few instances are known of this oppressive exercise of their power, and there are many instances on record of their purchasing land from their subjects. I have laid before the public translations of official documents, in which the sovereigns have been parties, containing the most irresistible proofs of the people having the uncontrolled right to dispose of their lands as they pleased, by gift, or sale, or devise, or in other ways. These translations are too lengthened to be introduced in this report, but they will be met with in the Journal of the Royal Asiatic Society of Great Britain and Ireland.

All lands in Dukhun were classed within some village boundary or other; and to this day these boundaries are guarded with such jealousy by the inhabitants as to be productive of broils and bloodshed on their slightest invasion. The village lands were divided into family estates, called Thuls, which bore the name of the family, and the estates bear the name to this day, although the family be extinct or Gutkool, as it is called; and half the estates in Dukhun are now Gutkool, but preserve their family names. These estates were hereditary and freehold, burthened only with the sovereign's land-tax, and assessments for village expenses, as a gentleman's estate in England is burthened with land-tax and assessments for highway and poor-rates, &c.; there were not any tithes, but in each village there were lands assigned for religious objects, either to temples or to sacerdotal persons. Every village had a constitution for its internal government; it consisted of the Pateel or chief, assisted by a Chowgulla; the Koolkurnee, or village accountant, kept the village records and details of assessment and revenue; and there

were twelve hereditary village officers, the well-known Bara Bullooteh, whose numbers were complete or otherwise as the population of the villages was capable of supporting them. All these officers and the chief land-owners formed a village council, called Pandreh, which managed the external and internal relations of the village, whether with respec tto raising the government assessments, managing its police, or in settling civil disputes, excepting in cases where Panchaeits or juries of five persons were specifically appointed to arbitrate by mutual consent of the litigating parties. And it is somewhat remarkable that this isolated and internal government has withstood the shocks of all the changes of dynasties, invasions, rebellions and the destructive anarchy which have so frequently disgraced the annals of India.

A certain number of villages constituted a Naikwuree, over which was an officer with the denomination of Naik. Eighty-four villages constituted a Deshmookee, over which was an officer called a Deshmook, or governor,* possibly equivalent to our lord-lieutenant of counties; this officer was assisted by a Desh Chowgulla; and for the branch of accounts there was a Deshpandeh or district accountant and register. The links connecting the Deshmooks with the prince were Sur-Deshmooks, or heads of the Deshmooks; they were few in number. It is said there were also Sur-Deshpandehs. The Sur-Deshmooks, Deshmooks, and their assistants, Naiks, Pateels, and Chowgullahs, indeed all persons in authority, were Mahrattas: the writers and accountants were mostly Brahmans. Such was the state of things under the ancient Hindoo governments. The Moosulmans on their conquest, in the civil divisions of the country, introduced the terms of Soobeh (a province), Pergunnah (county), Tallook (manor, lordship), and Turruff (a division of a county). The Hindoo hereditary officers were deprived of their authority, (excepting those in the village constitution,) but, very liberally, they were not deprived of their tenures; and their places were supplied by Zemindars,† Maamlutdars, Sheristehdars, Havildars, &c.

I have stated that the family estates were called Thuls, from the Sanscrit *Sthul*, "firm land;" and in case the family became extinct or Gutkool, from the Sanscrit *Gut*, "gone, passed away," and *Kool*, "a race or family," the property did not pass to the sovereign, but it was at the

* Called also Desaee or Deshaee in some parts.

† Mistakes, very serious in their consequences, have been made with respect to the supposed rights of Zemindars. They were introduced by the Moosulmans, superceding the ancient Hindoo Deshmooks and Desaees, and were government officers for the collection of the revenue, and for the civil government of districts. In Bengal, the British considered them proprietors of the soil, and constituted them as great freeholders; sweeping away the village freeholds.

disposal of the Pateel solely, or the village corporation conjointly, to do as they pleased with it; and I have multiplied proofs in my possession of freeholds having been created in such estates of extinct families, by letters of inheritance, called Meeras Putra, which were granted by the Pateel or village authorities for a sum of money; and such letters became title-deeds, similar to those of an estate in England. The law of succession by primogeniture not obtaining amongst the Hindoos, these estates became necessarily much divided, and the individual holders were called by the Hindoos Thulwaee or Thulkuree; and the light in which the Moosulmans looked upon such proprietors, when they took possession of the country, is sufficiently manifest by the term they applied to them, namely, Meerasdars, or patrimony-holders, from the Arabic word *Meeras*, "patrimony," "heritage," and *Dar*, "a holder;" and this is the term by which such proprietors are distinguished at the present day. The Meerasdars were of two kinds; the descendants of the original proprietor, whose *surnames* and the name of the estate or thul were identical, and those who had obtained a share of the estate by purchase or otherwise, whose surnames were not the same as that of the estate. In no instance, that I am aware of, have the former class documentary proofs of their right; with the latter class documentary proofs are not uncommon.

There is further proof of the Moosulmans having acknowledged hereditary rights in the term they applied to the Deshmooks, Desaees, Deshpandehs, and others, namely, Hukdar, *Huk*, in Arabic, meaning "right," and *Dar* "a holder;" these persons in virtue of their offices having lands in tenure and fees in money and kind in the districts in which these duties lay. The Meerasdars considered that they might be temporarily dispossessed of their freeholds in case of non-payment of the government assessments and dues, but they claimed to resume them whenever they had liquidated their debts; and they did not consider the question of these freeholds compromised by the government doing justice to itself, any more than the existence of freehold property would be questioned in England because the owner might be compelled to yield up his property in payment of arrears of land-tax, poor-rates, &c.

Meerasdars.—Meerasdars set a very high value upon their lands, and they clung to them with that feeling of personal and family pride which are characteristics of freeholders in Europe; even under the most grinding oppressions of their own government and its local officers, it was only when driven to despair that they abandoned them. The Meerasdar had to pay the government land-tax, all fees in kind to the district and village officers in common with the tenant at will or leaseholder; more-

over, he had to pay a tax applicable to himself only, called Meerasputtee, a kind of smart-money for the distinction his freehold gave him; this was levied every third year. Such was the Meeras tenure of land. His advantages were, first, the distinction; next, his being a constituent of the Pandreh, or village corporation, which the mere renter was not; and thirdly, in some parts of the country where such taxation existed, he was exempt from marriage fees, widows' marriage fees, buffalo tax, hearth tax, and he may have paid a diminished per centage, in the rights of district officers levied in kind. Of late years, from the low prices of agricultural produce and the comparatively heavy money assessments, Meeras-land has scarcely had a saleable value. The terms Meerasdar and Wuttundar have usually been considered identical, but in some village papers I observed them classed separately; and, on asking for an explanation, was told that the Wuttundars were hereditary office-bearers, or the relations of hereditary office-bearers with the possible right of succession, whilst the Meerasdars were merely hereditary landholders: a Wuttundar would necessarily be a Meerasdar, but a Meerasdar was not necessarily a Wuttundar.

Oopuree.—From the extinction of numerous Mahratta families who were in possession of estates, a considerable portion of the land in Dukhun is without proprietors, and much of it is rented to Oopurees or annual tenants by the Pateel or village corporation, under native governments; but, under the British government, by the collector or his officers. The term Oopuree means "a stranger," or a renter of land in a village in which he has not corporate rights: of course, Meerasdars can let their lands to each other, but they do not become Oopurees. The Oopuree holds his lands on the Ooktee, or word-of-mouth tenure, which is a verbal agreement for one year.

Kowl Istawa.—The third tenure is that of Kowl Istawa; *Kowl* means a contract, and *Istawa* is applied to lands let under their value. In practice, to induce cultivators to break up land that has long lain waste, a lease is given of three, five, seven, or nine years; the first year a trifling rent is fixed, and it is annually increased, until in the last year of the lease the full rent is paid; this tenure is highly desired, and great abuses exist under it: the permanently assessed cultivator is prompted to quit his village, and abandon even his hereditary lands, and get Kowl Istawa lands in another village: and the moment the favourable lease is up he changes his location, and endeavours to obtain similar terms elsewhere: the practice, therefore, is detrimental to the permanent revenue, detrimental to the sound advancement of agriculture, and detrimental to the cultivator himself in encouraging vagrant habits. The local authorities also are found to be great occupiers of Kowl Istawa lands.

Owand tenure.—Any inhabitants of a village, cultivating lands in a neighbouring village, but not residing in that village, do so on the Owand tenure. The rate and terms are the Ooktee, and with respect to the village such cultivator is, in fact, an Oopuree, but his distinctive appellation is Owand-Kuree.

The above are the tenures on which the government land revenue is raised, which in the four collectorates of Dukhun amounts to 82·372 per cent. of the whole revenue; this per centage, however, includes some trifling rents from government lands, gardens, orchards, grass lands, and sheep grazing, quit rents, fees, Hukdars, and extra cesses.

Tenures involving alienations of lands.—I have now to speak of tenures which involve alienations of lands, from a few beegahs in a village, to whole districts: these are *Jagheer* and *Eenam* in Khandesh; *Surinjam*, *Eenam*, and *Doomalla* in the Ahmednuggur Collectorate; *Eenam*, *Surinjam*, and *Eesaphut* in Poona; and in Dharwar, *Jooree Eenam*, *Surwa Eenam*, and *Jagheer*: at least, such terms appeared in the population returns sent to me, and in the public papers which I have.

Jagheer.—Jagheer, which is a Persian word in its orign, is applied to lands given by government (or the government share of the rents) for personal support, or as a fief for the maintenance of troops for the service of the state: some service is implied in the personal as well as in the military Jagheer. In the Collectorates in Dukhun upwards of 400 populated villages appear to be alienated in Jagheer.

Eenam.—Eenam is a word of Arabic origin, meaning a "gift," "present;" and lands so held should be entirely free from tax to government; but a subsequent explanation of various tenures will show that Eenam has a much wider signification than is generally supposed. This tenure is very extensive in Dukhun; for independently of the grants of whole towns and villages to individuals, of which there are 231 alienated in the Poona collectorate alone, and the other collectorates have a proportional share; independently also of grants for temples and religious institutions, almost every village has Eenam land held by the Pateel, Koolkurnee, and Mahrs, and very commonly the Deshmooks and Deshpandehs have also land rent free appertaining to their offices in the villages of their districts. The Bara Bullooteh, or twelve village artizans and officers, have often Eenam lands, but their Eenam is qualified by the imposition of some professional service, and it pays also a quit rent. Many of the Eenams are very curious in their objects; for instance, at the village of Wangee, Pergunnah Wangee, Poona collectorate, 15 beegahs of land to a mendicant for reading stories before the goddess Dawai at her festival; 15 beegahs to the tabor players at the temple;

30 beegahs to the tumbling and dancing women at the temple; the clarionet and double-drum players had respectively similar Eenams; the gardener, for the supply of flowers, had 30 beegahs, or 22½ acres. These Eenams existed untouched under the bigoted Moosulman government, and still remain.

Surinjam.—Lands held in Surinjam involve the condition of military service: the term is of Persian origin, meaning "furniture," "apparatus," implying that the lands are to defray the expense of equipment: in fact, Surinjam is synonymous with military Jagheer. In the Poona Collectorate 181 villages appear to be alienated in Surinjam.

Doomalla.—Doomalla, in the etymology of the word, means "two rights" or "properties," from *Do* two, and *Maal* property: the term is only found in the list of villages of the Ahmednuggur Collectorate, applied to villages and lands granted to individuals, on which government has a reserved right. In this sense the tenure appears to be that of quit rent, and the term is synonymous with the Jooree Eenam of the Dharwar Collectorate. In the Ahmednuggur Collectorate 581½ villages appear as Doomalla, but this, no doubt, includes Jagheer and Eenam villages.

Eesophut—In the Poona Collectorate the term Eesaphut is applied to 37½ villages: it is probably a corruption from the Arabic *Zeaphut*, meaning "feast," "entertainment." Lands so held are rent free, and may have been given to assist in celebrating festivals.

In the Dharwar Collectorate the terms Jooree Eenam, Surwa Eenam, and Jagheer occur: the first corresponds to the Doomalla of Ahmednuggur, and is, in fact, a quit rent tenure; the second means "all gift," from *Surwa* "all," and *Eenam* "gift," there not being any tax or fee upon these lands: Jagheer has been explained before.

Tenure of Deshmook and Desaee.—It is a general belief that these officers were coeval with the establishment of the land institutions of the Mahratta people.* Deshmooks were the civil governors of districts, collectors of the revenue, and executive officers of the government. The name is probably a corruption of the Sanscrit *Deshuk*, a governor or ruler. In early times they were exclusively Mahrattas, and not Brahmans or Moosulmans. The importance of the office is attested by the fact that, in the earliest mention of the chiefs of the present great Mahratta families, they are styled *Deshmooks* of such and such districts. Their rights were hereditary, and saleable, wholly or in part, like those of every other hereditary office or right: the right of alienation

* I mean, of course, long antecedent to the Moosulman invasion.

is proved by different casts being now associated in the office. At Ahmednuggur a *third* of the Deshmookee belongs to a Brahman, and *two-thirds* to the ruling Mahratta family at Nagpoor. Similar instances are very numerous. In some cases a Deshmook is also Pateel of one of the villages in his district. The rights and emoluments of the Deshmook are very extensive, but not uniform throughout the country; they had a per centage on the revenue varying from one to five per cent. In the Poona Collectorate the mean charge for Deshmooks and Deshpandehs amounted to 3·06 per cent. of the *gross revenue*, but on the *nett revenue* it amounted as nearly as possible to six per cent; although these persons are now *non-efficient*, their authority being superseded. As a single illustrative instance, it may be as well to state, that at the village of Ankoolsur, Talook Ahmednuggur, out of a village revenue of 4533 rupees, the Deshmook received 265 rupees, and the Deshpandeh 150 rupees; the former sharing 5·84 per cent., and the latter 3·31 per cent. Their next advantage is in some of them enjoying villages in free gift; the third, in possessing Eenam land in most of the villages in their districts, sometimes to a large amount. At Mohol Talook Mohol, the two sharers in the office of Deshmook have each 450 acres of free (or Eenam) land. The fourth right of the Deshmook is a portion of grain from each village, called *Googree*, from all the land under cultivation. In addition to the above, from some villages they were entitled to a sheep and some butter annually; from some villages a dress, from others a turband, and where sugar-cane was cultivated, they had a portion of the raw sugar. They possessed the above advantages on the tenure of executing the duties previously stated. They were to a district what a Pateel is to a village.

Deshpandehs.—The Deshpandehs are contemporary in their institution with the Deshmooks; they were the writers, accountants, and registers of districts; they were always Brahmans. The terms appear to be derived from the Sanscrit *Desh*, country, and *Punnah*, to do business. They were to districts what Koolkurnees were to a village: they had, and have nearly the same rights and emoluments as the Deshmooks, but in a diminished ratio of from 25 to 50 per cent. The offices of Deshpandeh and Koolkurnee are sometimes found united. Their duties are in abeyance, but, like the Deshmooks, they enjoy their rights.

Pateel.—The next and the most important tenure of all is that of Pateel or headman of towns and villages. Pateel is a Mahratta term, and may be derived from the Sanscrit *Puttruh*, "deed," "lease," the Pateel anciently having had the disposal of all vacant lands in his vil-

lage by deed or lease. Originally the Pateels were Mahrattas, but sale, gift, or other causes have now associated in the office various casts, and there are sometimes six or seven or more sharers in the office,—Brahmans, Mahrattas, Moosulmans, Shepherds, Lingaeets, &c., and these not holding in equal proportions. I have elsewhere* given a translation of a very remarkable and curious Mahratta document, proving in the most distinct manner the right of the Pateel, not only to sell his family, or hereditary property, and the lands he held in virtue of his office, but also the lands of extinct families, and his other emoluments and advantages ; but, in doing so, he also alienated part of his dignity, rights, and authority as Pateel : the honours went with the lands. The rights and emoluments of the Pateel are very numerous ; free land, fees of grain on the cultivation, called googree, presents on investitures, on granting letters of inheritance, on marriages; annual presents from the shoemaker of shoes, from the potmaker of pots, from the shopkeepers of cocoa-nuts, &c , market fees, *all the sheeps-heads offered in the temple of Dawai !* daily service, and supply of wood and water by the Mahr and the potmaker ; precedence in all religious or other festivals, in communicating with government, and with others. The details of the translation before noticed show with what jealousy the Pateel maintained all the minutest rights and dignities. Of such importance and so profitable was the office, or in such estimation was the dignity of Pateel anciently, that princes of the Mahratta empire established themselves wholly or in part in the office in various towns and villages ; *Holkur*, for instance, at Munchur ; *Seendeh (Sindiah)*† at Jamgaon ; the Nagpoor *Bhosleh* at Ahmednuggur, and *Powar* of Dhar at Multun and Kuweeteh. There are traditional accounts of a share of the Pateel's office having been sold for 7000 rupees.

The right of the Pateel to dispose of the village lands not occupied by hereditary proprietors, together with his responsibility for the government revenue, involves the proof that the government assessment was anciently Mozehwar, or by the whole village, and not by direct agreement between the government agents and individual farmers. The village, in fact, was assessed at a certain fixed sum, which was called the *Tunkha*, which means an assignment; and this Tunkha appears in village accounts to this day, although no longer a standard of assessment, as the

* Journal of the Royal Asiatic Society.

† This prince has six out of seven shares in the office ; nevertheless the poor Mahratta who has the seventh share has precedence of the prince.

British government settles directly with the farmer, and has also abrogated the right of the Pateel and the village corporation to dispose of waste lands; in alienated villages, however, these rights remain. Although the translation before noticed gives a minute detail of the rights and emoluments of the Pateels of Kuweeteh, it is to be understood they are not uniform either in number or value throughout the country. An idea of the value of the Googree, or right to a share in the grain-produce of cultivated lands, may be formed from the fact, that at Kurjut, Ahmednuggur collectorate, in 1827, there were 8491 beegahs of land under cultivation, and the Pateel was entitled to 128 seers for every 120 beegahs; he received therefore, 9057 seers of grain, a sufficiency for the annual support of 25 persons.

The duties of the Pateel were, to be responsible for the revenue of the village, to superintend its police, and regulate its internal economy. He had power to seize, imprison, and fine offenders.

With regard to joint proprietary in the office, independently of shares being held by different casts and families, the Hindoo law of inheritence, which gives equal shares of all property to all children, necessarily made many joint owners in a family; but as the executive duties are only performed by the head of the family, this person is called *Mokuddum*, "chief" or "leader;" and the term of course is applicable to the head of each proprietary family, who is designated in the village papers as half Mokuddum, quarter Mokuddum, or seventh Mokuddum, according to the share of the Pateelship held by the family.

Koolkurnee.—The next village tenure is that of Koolkurnee, from the Sanscrit *Kool* "to count," and *Kroot* "to do," "make;" literally an accountant. The office is of very great importance, for the Koolkurnee is not only the accountant of the government revenue, but he keeps the private accounts for each individual in the village, and is the general amanuensis; few of the cultivators, the Pateels frequently inclusive, being able to write or cypher for themselves. In no instance have I found the office held by any other cast than the Brahmanical. The office is sometimes united with that of Deshpandeh, and not unfrequently to that of Johesee or village astrologer. The Koolkurnee, like the Pateel, has Eenam land, sometimes salary, fees of grain, and miscellaneous rights of butter, raw sugar, &c., rarely having equal rights, either in number or value, with the Pateel, but commonly averaging from 25 to 75 per cent. below. Where the villages are very small, there is only one Koolkurnee for several villages, as in the case of Turruff Muhr Khor, Poona collectorate, where the duties of this individual extend to one small town and

eleven villages. He is here paid by a money rate for every 30 beegahs of land under cultivation; it varies from 1 rupee the 30 beegahs to 3 rupees.

Unlike the Deshmooks and Pateels, no instance came to my knowledge of shares of the office being alienated from the family; the numerous sharers being all connected by ties of blood, who each in turn take their annual duties; and these sharers are sometimes so numerous, that at one town the execution of the duties only came to the same individual after a lapse of 20 years. The executive duties should be confined to the same person.

Mahrs Tenure.—A very important tenure in villages is that of the low-cast people, called *Mahr* by the Mahrattas, and *Dher* by the Moosulmans. They have Eenam lands in all villages, divided into *Hurkee* and *Arowlah*; the former is rent free, and generally bears a small proportion to the latter, which pays a low quit rent. The Mahrs conceive that they have the right to mortgage or otherwise dispose of lands held for the performance of specific duties to the village and the government, and numerous instances of mortgage came to my knowledge; but whether they can wholly alienate their lands or not, they *cannot* absolve themselves and their descendants from their duties: these are to cut wood and grass for government officers and travellers, to act as guides, as porters to carry baggage from village to village, and to go as messengers; they have to attend strangers and see to their wants being supplied, and if the strangers be of consequence, they or the Ramooses have to look to the safety of their baggage at night. They are the guardians of all village land-marks; they are the Pateel's messengers, (something like parish beadles,) and it is their duty to carry the collections to the treasurer of the district; they have to pass on all news or information received, whether written or verbal, whether by sign or by token, to all the surrounding villages, and it is perfectly astonishing the rapidity with which intelligence is diffused by their means. It is no uncommon thing for a distant public event to be whispered about in towns before any account of it has been received by the government post. Occasionally the answer to my inquiries respecting the duties of the Mahrs was, that they were to do every thing they were ordered, whether by the Pateel, the village corporation, or by the government. There are many families of them in every village: in some villages they have to pay a tax to government called *Rabta Mahr*, and this is in lieu of personal service in cutting wood and grass for the officers of government, but it does not absolve them from their other

duties. So strictly is it their province to cut wood and grass, that their signature to all village or public documents is a sickle or hatchet to cut grass and wood, and a rope to tie them up. In addition to their Eenam lands, the Mahrs, in virtue of their office as one of the Bara Bullooteh or twelve village officers, craftsmen, and professions, receive fees in kind from all the cultivators; the fee in kind is a per centage upon the produce, but it is not uniform in amount throughout the Dukhun. These twelve village officers are divided into three classes, according to the supposed importance of their services to the village; the first class in some villages received 50, the second 20, and the third 10 or 15 bundles or sheaves of Joaree, (*Andropogon sorghum*,) stalk and grain included upon every 1000 cut down; and the same proportion of other grains. Many farmers in various parts of the country assured me that they put by 25 per cent. of their produce for the village craftsmen and professions: and as the Mahrs from their usefulness share in all those classes, their returns must be considerable: the individual benefit depending of course upon the magnitude of the body constituting this class of persons in the village. As low casts do not cultivate their Eenam lands, they derive less advantage from them than other Eenamdars, but make the best terms they can with the Koonbees to cultivate their lands for them. The Mahr does not pay any tax to government upon his Bullooteh. In the whole of the duties of the Mahrs, whether for government, the village, or individuals, they are not bound to go beyond the village next to their own: here they hand over their charge and return.*

Bara Bullooth Tenure.—The twelve craftsmen or professions which were originally in every village were, the *Sootar* (Carpenter), *Chambar* (Shoe-maker), *Lohar* (Ironsmith), and *Mahr*; these constituted the Torlee Khas or first class. In the Mudlee Khas, or second class, were the *Pureet* (Washerman), *Koombar* (Pot-maker), *Nahwee* (Barber), and *Maang* (Skinner and Rope-maker). And in the third or Dhaktee Khas, the *Kohlee* (Waterman), *Johesee* (Astrologer), *Gooruw* (cleaner of, and attendant at the temple), and the *Sonar* (Silversmith): and, since the Moosulman rule, the *Moolana* or Moosulman priest and schoolmaster has been added. These persons, in their several lines, and according to their several abilities, were to do for the cultivators individually and the village collectively whatever might be required from them; and they were paid by an an-

* In speaking of the duties of the Mahrs I ought to have used the past tense instead of the present in *some cases*, government having partly absolved them from duties, the performance of which is their tenure for holding their lands and fees.

nual per-centage in kind upon the produce of the farmer; and this was called their Bulloteh, whence the term Bara Bulloteh: the fee being called Bulooteh, and the receiver of it Bulloo'eh dar. Very rarely could I get either farmer or Bu lootehdar to state specifically what the one gave, and the other was entitled to receive; it depended very much upon the crops, and also upon the extent of services performed for each individual cultivator. These craftsmen have frequently small portions of Eenam lands, and part of their Bullooteh goes to government as a tax.

Shet Sundee Tenure.—Lands were given to a kind of militia in the districts in place of pay, for the performance of certain duties, principally in the protection of their villages: this tenure is called Shet Sundee from *Shet* "a field," and *Sunnud* "a grant;" constituting the holders, in fact, a landed militia. Although this tenure may have been general at one period, I only observed lands set apart as Shet Sundee in five Pergunnahs of the Poona collectorate, and I remarked it also at Kurmulla, Ahmednuggur collectorate.

Tenure of Chowgulla.—There are several other tenures, of which a brief notice only may be given. The Chowgulla is the Pateel's assistant; he is found in most villages; sometimes he has a trifling grant of land, but most commonly grain-fees from the landholders. This personage is called Buglah where the Kanree language is spoken.

In some Turruffs a Havildar is met with; the term is of Arabic origin, from *Hawala* "charge," "custody," and *Dar* "agent," "holder." This officer was introduced by the Moosulmans as a supervisor in the collection of the revenue of a certain number of villages. He replaced the Hindoo Naik, who is still met with in some of the hill districts. The Havildar was paid by half a seer of grain from each beegah under cultivation; and for the Hindoo officer the same is levied, under the name of Naikwaree. At Kanoor, Ahmednuggur collectorate, the Naikwaree is 12 seers of grain on every 30 beegahs under cultivation.

Tulwar.—In the southern villages bordering on the Kanree tracts, I met with the village or Turruff officer called Tulwar: but the term is unknown to the genuine Mahrattas. His duties assimilate him to the Havildar and Naik of more northern tracts.

Tenure of Ramooses.—Between the parallels of latitude 17° and 19° north, and longitude 73° 40′ and 75° E., there are few villages in Dukhun without their Ramooses. These vagabonds are thieves by birth and cast, which is abject: most of the villages have them in employ to guard the village from robbery. In some villages they have Eenam lands, but they are generally paid in fees of grain upon the cultivation.

There is a perfect community of interest amongst the fraternity, however dispersed; and as they are dissipated, idle, and reckless, they not unfrequently assemble in bands, take to the hills, and commit depredations in the country, and it is necessary to chase them back to their villages by means of the regular troops. They are expert sportsmen and good shots.

Bheels.—Where the Ramooses are wanting, their places are mostly supplied by the Bheels, or by the Kohlees; the former are low casts, the latter are Shoodrahs. Their duty is to afford protection to the villages, and they have either Eenam lands or fees in grain. In many parts of the country, particularly in Khandesh, the inhabitants of entire villages, and even districts, are Bheels, or Kohlees (Coolies).

Sheteh.—Sheteh is the person by common consent admitted to be the head and spokesman of the mercantile and trading classes, in places in the districts where they are in sufficient numbers to require one; and as combination is universal, he is of some importance in the districts as their organ in regulating prices. The *Sheteh* is assisted by the *Mahajun*, which properly means a banker; but, as the colleague of the Sheteh, he is an inferior personage in the districts: both these people, in some towns and villages, have trifling Eenam lands and claims for money and grain; but on what tenure of service to the community is not very apparent.

Sur Pateel, and Sur Deshmook, and Sur Desaee.—I should scarcely have introduced any mention of the Sur Pateel, and Sur Deshmook, and Sur Desaee, as it has not come to my notice that they hold lands in tenure, but their names frequently occur in village accounts as Hukdars,* or entitled to certain rights in money, grain-fees, &c. One of the Sur Pateelships is vested in the great family of Eshwunt Rao Dabareh, of Tullegaon; and one of the Sur Desaeeships in the ancient family called Chaskur. Captain Grant Duff, in his History of the Mahrattas, makes mention of several Sur Deshmooks, and says, that Arungzebe allowed the old Sur Deshmooks 2 per cent. on the revenue. But the Sur Deshmookee of modern times which appears in all village accounts, was 10 per cent. of the Moghul revenue, exacted by Sewajee from the Moosulmans; it was levied over and above the land tax. The sufferers, therefore, by Mahratta violence were the Mahratta cultivators; and on the whole of the possessions of the Moosulmans coming into the hands of a Mahratta government, the Sur Deshmookee should have been abandon-

* *Huk* "a right," and *dar* "a holder."

ed, but it remains to this day; for instance, at Jehoor, near Ahmednuggur, the Tunkha, or government revenue or *assignment*, from the town was 10,817 rupees, 2 qr., 3 reas; the Sur Deshmookee 1350 rupees, 3qr., 3 reas; but the Kumal, or total sum raised from the cultivators, including village expenses and Hukdars, was 19,363 rupees, 3 qr., 1 reas: so that the Moosulmans originally took little more than half of the revenue now raised from the town, that is to say, the Moosulmans took 10,817 rupees; then came Sewajee, the Mahratta, and wrenched from them 10 per cent. of their revenue, which should have been 1081 rupees. The Moosulmans, instead of paying it out of 10,817 rupees, clapped the demand of Sewajee upon the town as an additional burthen; and instead of honestly fixing it at 1081 rupees (10 per cent. of 10,817), they adroitly took occasion to exact a little more from their Mahratta subjects.

Many individuals have shares in the village revenues under the names of *Mokassa*, *Sahotra*, *Babtee*, and *Nargowra*. The most intelligible way to describe these, is to say that persons have money assignments, amounting to a definite per centage on the revenue, under these names. In their origin, Mokassa is 66 per cent., Sahotra 6 per cent., Babtee 25 per cent., and Nargowra 3 per cent. of the *Chout*, or fourth of the whole Moghul revenue, which was extorted from the Moosulmans by the Mahrattas. Sewajee and his chiefs shared it amongst themselves; the chiefs had the Mokassa for military services; the Sahotra was given to the Punt Suchew, one of Sewajee's ministers; the prince's own share was the Babtee; and the Nargowra, which is synonymous with Sur Pateel, or chief of all the Pateels, was at the disposal of the prince. As these grants were hereditary, the equal division of property and rights amongst children has occasioned the reduction of some of the shares to the most trifling amount where families have multiplied.

Such are the tenures that came under my notice; and it is necessary to state that, with the single exception of Surwa Eenam or "entire gift," there was an obligation of specific service on the individual or parties enjoying advantages under the several tenures; the non-performance of these duties involved the forfeiture of their rights; but independently of such forfeiture, all grants whatever (unless specified to the contrary) were resumable by the sovereign or other grantee. Grants for religious purposes were rarely recalled; bur for other objects they were frequently abrogated, particularly *Jagheer*, *Surinjam*, and *Hukdar* grants. To such an extent did this exist under the Peshwa's government, that the Hon. M. Elphinstone, in his report as commissioner, enumerates as an

item of revenue, *Wuttun Zubeet,* or sequestered lands of Zumundars, which yielded annually 50,000 rupees.

Revenue.

A few figures perspicuously arranged, are more efficacious in affording just impressions of the resources of a country, their ramifications, pressure, and availability, than the most laboured verbal details. In 1827-28 the assessments in the four collectorates of Dukhun amounted to 8,435,214 rupees, 3 qr. 79 reas, being a diminution of 539,399 rupees, 2 qr. 80 reas in the revenue of Fuslee 1231, A. D. 1822, as stated in Mr. Chaplin's report; from this sum also were to be deducted the remissions of 415,0[illegible]0 rupees, 1 qr. 25 reas in the Ahmednuggur, and 416,320 rupees, 3 qr. in the Poona collectorate in 1827-8, amounting to a total diminution of 1,360,725 rupees, 3 qr. 05 reas, or 15.16 *decl.* per cent. of the revenue of 1822.

The revenue of 1827-28 in its constituents is shown in the following table:—

Denomination of Revenue.	Fuslee 1237.—Revenue, A. D. 1827-28.			
	Poona Collectorate.	Nuggur Collectorate.	Dharwar Collectorate.	Khandesh Collectorate.
	rupees. qr. reas.	rupees. qr. reas	rupees. qr. reas.	rupees. qr. reas.
Land revenue	1,5 6,323 .. 37	1,8 5,8 7	1,945,323 2 08	1,664,904 3 32
Sahyer*......	231,262 1 ..	59,007 3 78	334,668 .. 85	13[illegible],710 3 ..
Customs......	241,114 1 25	159,150	141,524 2 46	155,560 3 ..
Miscellaneous.	3,391	.. .. ..	.. .. ..	35,556 2 68
Total.........	1,992,000 2 62	2,033,994 3 78	2,421,516 1 39	1,987,733 .. :
Grand Total 8,435,244 rupees 3, qr. 79 reas.				

From the preceding table it will be seen that in the several collectorates, although of very disproportionate superficial extent and population, in Ahmednuggur, Poona, and Khandesh there is a close approximation in the total amount of their revenues, although with some difference in the value of their great branches.

* Sahyer is the revenue raised from shops, markets, liquors, &c. Sahyer is a "market" in Sanscrit.

The following table exhibits the proportion per cent. of the great branches of the above revenue.

Denomination of Revenue.	Proportion per cent. of the great branches of revenue.			
	Poona Collectorate.	Nuggur Collectorate.	Dharwar Collectorate.	Khandesh Collectorate.
Land revenue.	per cent 76·12	per cent. 89·275	per cent. 80·365	per cent. 83·76
Sahyer	11·62	2·900	13·820	6·63
Customs......	12·10	7·825	5·815	7·82
Miscellaneous	0·16	..	..	1·79
	100.	100.	100.	100.

There is considerable uniformity in the respective proportions of the land revenue in the different collectorates. Poona has the smallest, but it is compensated for in the magnitude of the Sahyer and customs. In Ahmednuggur the proportion of the land revenue exceeds that of Poona by 13 per cent, but this is counterbalanced by the singular smallness of the Sahyer branch. In the land revenue of Dharwar and Khandesh there is a sufficient approximation to a mean per centage for the four collectorates, which averages 82·30 *decls.* per cent. The whole revenue of England being £52,000,000, has only a land revenue of £2,000,000 or 3·846 *decls.* per cent. The whole revenue of France being £40,000,000, the land revenue is 12,000,000. or 30 per cent.

The following table shows (in 1827-28) the amount of the land revenue in each collectorate, the number of cultivators, the average rent of farms, the number of British populated villages, and the average revenue of a village : the last column is intended to show the pressure (including land Sahyer and customs) of the assessments and taxes, viewed as a capitation tax.

Names of Collectorates.	Number of British populated villages.	Average revenue per village.	Land revenue.	Number of Cultivators.	Average rent of farms.	Land revenue, Sahyer, Customs, &c., viewed as a capitation tax.	
		rup. qr. rs.	rup qr. rs.		rp. qr. rs.	rp. qr. rs.	£. *s.* *d.*
Poona......	1469½	1253 1 98	1,516,323 .. 37	52,668	28 3 16	4 1 78	0 8 10¾
Nuggur	1878½	1082 2 99	1,815,837	41,948	43 1 15	3 3 77	0 7 10¼
Khandesh	2367½	839 3 7	1,664,905	44,608	37 1 33	4 1 92	0 8 11½
Dharwar. ...	2104	924 2 33	1,945,323 2 80	60,701	32 .. 19	3 1 60	0 6 9½
Total	7819½	887 3 32	6,942,388 1 77	199,925	34 2 90	4 .. 02	0 8 0

The population, inclusive of Sholapoor and Cheekoree and Munowlee, of the Company's possession in Dukhun, but exclusive of alienated villages, is 2,105,886 souls, and the gross revenue 84,435,245 rupees; equal, therefore, to 4 rupees, 0 qr. 02 reas per head.

In forming the above table, the collectors were good enough to supply the number of villages and cultivators in 1827-28, and the amount of the land revenue was obtained from the Accountant-General's office. In striking the average revenue per village, I have omitted, in the division of the Dharwar collectorate, 175 villages, (subsequently reduced to 155,) which I found by the population returns lately completed were uninhabited, but parts of whose lands were under cultivation by neighbouring villagers, and therefore included by the collector in his list. In Khandesh 330 villages have been struck out under similar circumstances. In Poona and Ahmednuggur, villages of this class are very limited in number, and I have, in consequence, not made any deduction on their account.

To give a fair average of the village revenues in the Poona collectorate, 151,241 rupees, including a share of the customs, have been deducted from the whole revenue for the city of Poona previously to striking the average. The manner in which the Poona capitation tax is struck is as follows:—1108 towns and villages sent in population returns, containing 331,615 inhabitants, averaging 226 souls and a fraction to a village. The population of the city of Poona (81,315 inhabitants) being deducted before striking the average; of these villages 212½ are alienated, leaving 895½ British villages with a population of 283,567, including Poona. These in 1827-28, yielded a gross revenue of 1,261,711, averaging 4 rupees, 1 qr. 78 reas to each person.

The capitation rate in the Ahmednuggur collectorate is obtained as follows: In 1827-28, 1877½ towns and villages were on the collector's list; they contained 494,669 souls, estimated from the average number of inhabitants to a village, namely, 263·47, struck from the census of 1822, to which the *present* population of the city of Nuggur is to be added, namely, 21,208. The revenue from the collectorate was 2,033,994 rupees, 3 qr. 78 reas; equal, therefore, to 3 rupees, 3 qr. 77 reas per head.

In Dharwar the averages have the following elements:—in 1827-28, 2279 British towns and villages produced a revenue of 2,421,516 rupees, 1 qr. 39 reas. This included the villages, revenue, and population of the Talooks of Cheekoree and Munowlee, received from the Kolapoor state; population returns were not received from these Talooks; their

revenue from 225 villages, namely, 197,406 rupees, 3 qr. 29 reas, is therefore deducted from the total revenue of the collectorate, leaving 2,224,199 rupees, 2 qr. 10 reas, and 2054 villages. From the latter are to be deducted 175 depopulated villages, but having a small part of their land cultivated by neighbouring villagers, leaving 1879* British villages, with a population, agreeably to the census, of 653,892 souls, giving 3 rupees, 1 qr. 60 reas per head.

There is some difficulty in ascertaining how the revenue of Khandesh would fall as a capitation tax, in consequence of the increased number of villages (335½) rendered productive since 1825-26, (the date of the population returns,) their population not being known. In 1825-26 the inhabited villages amounted to 2032, and 330 were Pyegusta, i. e. deserted, but having part of their land cultivated by neighbouring villagers. Supposing the new villages to be peopled in the same ratio as the old ones, the number of inhabitants in the government villages in 1827-28 would have been 443,518, which is 24,031 souls more than I have put into the population returns: and as the revenue was 1,987,733 rupees, the people averaged an individual payment of 4 rupees, 1 qr. 92 reas: nevertheless, I have reason to doubt the actual increase in population to the extent I have given Khandesh credit for; and should it have remained stationary, the revenue as a poll-tax would amount to 5 rupees, 1 qr. 40 reas per head.

With respect to the branch of revenue called Sahyer, it will be seen that the different collectorates raise it in very unequal proportions. The unusual lowness of it in the Ahmednuggur collectorate is of difficult explanation. The following table shows the number of persons of each class paying this tax, the amount paid, and the average per head.

Collectorates.	Number of taxable persons.		Amount of taxes.	Average per head.
	Sahyer.	Bullooteh.	rup. gr. rs.	rup. gr. rs.
Poona........	14,551	8481	231,262 1 00	10 .. 16
Ahmednuggur.	9,287	4980	59,007 3 78	4 .. 54
Dharwar......	29,046	2811	334,668 .. 45	10 2 02
Khandesh	9,147	2348	131,711	11 1 83

It is consequently found, that Ahmednuggur, with a greater num-

* Subsequently increased to 1899, with a population of 660,852.

ber of taxable persons in the Sahyer branch than in Khandesh, averages a payment per head of little more than one-third of what the shopkeepers, trades, and Bulloteh pay in Khandesh ; and the tolerable uniformity in the individual averages of the collectorates of Poona, Dharwar, and Khandesh, proves that their Sahyer taxes are raised equitably. I have to notice, that in village papers there is a want of uniformity in the classification of the extra cesses, sometimes articles being placed under the heads of Sahyer which bear upon the land, and others again being classed with the land which are money commutations for labour.

From the definite character of the elements in the preceding table, great confidence may be placed in the correctness of deductions from it. The numbers of taxable persons in 1827-28 were supplied to me by the collectors, and the amount paid is extracted from their Jummabundy settlements for that year.

Customs.—The customs vary considerably in the different collectorates; those of Poona, being above 12 per cent. of its whole revenue, may be looked upon as high, but their magnitude manifests a favourable commercial industry. Contrary to expectation, Dharwar, which has indications of internal comparative prosperity, has the lowest revenue from customs, with a greater population, a greater revenue, and falling lighter upon the people than in any of the other collectorates, and with more than ten times the number of manufacturers* to be found in Poona and Khandesh, nevertheless shows a commercial return 52 per cent. less than that of Poona, and even 25½ per cent. below the exhausted province of Khandesh. It seems anomalous that the proportional percentage of the customs on the whole revenue in Ahmednuggur and Khandesh should be identical, the population of the former being 23.75 per cent. greater than that of the latter, while a parity seems to exist in the wants and export resources of the people of both.

Expenses.—I have put into juxtaposition some of the items of expense in the collectorates, and their rate per cent. on the gross revenue ; but the want of a systematic classification of charges under common heads throughout the collectorates, renders a rigid comparison, item for item, unattainable. The information is extracted from the Jummabundy returns of the collectors for 1827-28. A government form for this paper for common adoption would render the multitudinous details involved in it more available for comparison by inspection than in the

* Thirteen thousand and forty-five weavers.

present forms. The total expenses of two of the collectorates only is given in the following tables.

Few comments are necessary, as the charges and the rate per cent. they bear upon the gross revenue of each collectorate are seen at a glance.

TABULAR VIEW OF THE EXPENSES.

Denomination of expenses.	Expenses 1827-28.											
	Poona Collectorate.			Nuggur Collectorate.			Dharwar Collectorate.			Khandesh Collectorate.		
	rup.	qr.	rs.	rup.	qr.	rs.	rup.	qr.	rs.	rup.	qr.	rs
Village & land expenses. ..	136.659	..	12	149,761	2	26	..	..	..	388,016	..	..
Native establishment for collections..	..	..	..	..	..	..	246,[illegible]74	3	80	157,202	2	..
Mokassa..	55,997	3	43	..	..	..	..	..	..	45,358	..	..
Hukdars.	61,005	3	00	11[illegible],876	1	25	..	..	..	..	..	..
Contingent charges, including presents..	..	..	..	101,055	3	22	190,768	3	39	339,410	3	..
Shet Sundee or native militia........	34,435	2	43	..	..	..	..	..	..	..	..	..
Pensions, Eenams........	..	..	..	466,493	3	89	33,522	2	91	45,619	2	24
Collector's salary........	..	..	..	59,653	1	33	113,745	..	42	93,277	1	75
European Judicial	..	..	..	53,546	2	58	..	..	..	16,909	1	41
Native Judicial	..	..	..	229,366	2	73	..	..	..	90,306	..	..
Total	288,098	..	98	875,754	1	26	584,211	2	55	1,176,099	2	40
Remissions ..	416,320	3	..	415,005	1	25	None.			None.		
To H.H. Seendeh	..	..	..	..	..	..	..	..	..	90,796	3	33

TABULAR VIEW OF THE PROPORTION PER CENT. OF EXPENSES.

Denominations of expenses.	Proportion per cent. of the expenses on the whole revenue in the several Collectorates.			
	Poona Collectorate.	Nuggur Collectorate.	Dharwar Collectorate.	Khandesh Collectorate.
Village, land and Sahyer expenses........	per cent. 6·86	per cent. 7·36	per cent. ..	per cent. 19·52
Native establishment for collections..........	..	..	10·17	7·92
Mokassa..............	2·81	..	..	2·28
Hukdars.............	3·06	5·70	..	..
Contingent charges....	..	4·96	7·87	17·08
Shet Sundee, militia...	1·73	..	..	..
Pensions, Eenams	..	8·18	1·39	2·29
Collector's salary......	..	2·93	4·69	4·67
European Judicial....	..	2·63	..	0·85
Native Judicial	..	11·27	..	4·52
Total................	14·46	43·03	24·12	59·13
Remission............	20·89	20·40	None.	None.
Grand Total..........	35·35	63·43	24·12	59·13

For the proper understanding, however, of some omissions in the above abstracts, short notices are called for.

Under the items of "village, land and Sahyer expenses," "Shet Sundee," "Mokassa," and "Hukdars," there are blanks in the Dharwar collectorate, the whole land expenses amounting to 24·12 per cent.; it is to be presumed the charges under these heads have merged in the "Native establishment for collections." Under Khandesh there is a blank for the Hukdars; the expense of these persons is no doubt included in "village, land, and Sahyer expenses." Under Nuggur there are blanks under "Mokassa" and "Shet Sundee;" they must be included in the "Land and village expenses." Of the omissions in the Poona abstract it is unnecessary to speak, as they are intentional.

The charges, revenue, magisterial, and judicial, upon the revenue of Ahmednuggur in 1827-28, amounted to 43·03 per cent., and remissions were granted in that year to the amount of 20·40 per cent.; the total

deduction from the revenue was 63·13 per cent. In Khandesh, without any remissions, the charges were nearly six-tenths of the whole revenue. In Poona I have only shown the charges which are strictly and permanently fixed upon the land in all the collectorates, which are not mutable, and therefore scarcely susceptible in justice of modification; these amount to 14·46 per cent.: they comprise village expenses, militia, Mokassa, and Hukdars. In Dharwar, the collector's establishment has been added to the above, and it brings the charges strictly bearing on the land to 24·12 per cent. on the revenue.

A review of the above tables and abstracts suggests the following observations. The collectorate of Dharwar, having the smallest area[a] (with the exception of Poona) of the collectorates of Dukhun, has the greatest population, and produces the greatest revenue, which bears lightest by average upon the inhabitants individually.[b] Judging from the lowness of the customs, it has the weakest indications of commercial industry; nevertheless, the manufacturers, particularly the weavers, exceed those of the other collectorates in the ratio of 100 to 11, or 89 per cent. The shopkeepers and trades people are very numerous, and their individual taxes[c] rise to the average of those of Poona and Khandesh. Finally, the means of the people (remissions not being called for) must be more efficient than in the other collectorates, and a proportional ratio of imports and exports might have been looked for.

Khandesh has the largest superficial extent,[d] a population[e] 29 per cent. less than that of Poona, or granting an increase to its population 15·72 per cent. less, with a revenue nevertheless equal to that of Poona, bearing in consequence with unusual pressure upon the people, its average being 5 rupees, 1 qr. 40 reas to each soul; involving the fact that the assessments in this collectorate are greater than in any of the others. Admitting, however, the estimated increase to the population previously noticed, (which certainly exceeds the truth,) the average[f] individual payment will still exceed that in the other collectorates. It is possible this apparent pressure may be referred to the extent of its garden cultivation, which is much greater than that of Dharwar, and, as far as I can judge from observation, that

a 9122 square miles, including the cultivated area of the Talooks Cheekoree and Manowlee.

b 838,757, including the estimated population of the Talooks of Cheekoree and Manowlee, 3 rupees, 1 qr. 6 reas per head.

c 10 rupees, 2 qr. 2 reas.

d 12,527 square miles.

e 371,404, but supposed this year to be 443,548 in government villages.

f 4 rupees, 1 qr., 92 reas.

of Poona and Ahmednuggur also. In Khandesh in 1826, there were 82,697 beegahs[a] of garden-land, being 9·36 per cent. of the whole cultivated land, the garden-land in Dharwar not amounting to one-half per cent. In the Nuggur and poona collectorates, in the towns of Kurmalleh, Kurjut, Angur, and Rawgaon, the proportion of garden to field-land in cultivation was 5·45 per cent. only. But, under all circumstances, the villages of Khandesh average[b] the least revenue in Dukhun ; it stands third in the number of its cultivators,[c] but second in the amount of the rent of its farms.[d] The magnitude of this rent, it is inferred, originates in the comparative high rate of assessment per beegah, and not in the greater size of the farms. I have not the number of beegahs of land in cultivation in 1827-28 in Khandesh, but justify my inference from the following data :—In 1826 there were 37,311 cultivators, and 883,548 beegahs under cultivation, averaging 23·68 beegahs to each farm.[e] Last year, there were 44,608 cultivators, and supposing them to hold individually the avera ge number of beegahs of 1826, the result will be as

cult.	beegahs.		cult.	beegahs.
37,311 :	88.348 :	:	44,608 :	1,056,345 ;

and as the land revenue of 1827-28 was 1,664,904 rupees, the rate per beegah is therefore 1 rupee, 2 qr. 30 reas,[f] which exceedsg that of the other collectorates from 50 to 100 per cent.

In the Sahyer branch of revenue the increased pressure is still visible upon the people ; it exceeds the mean pressure of Dharwar and Poona 10·35 *decl.* per cent., and that of Ahmednuggur in the extraordinary ratio of 63·91 per cent.

The customs' per centage on the whole revenue is identical with that of Ahmednuggur, although, in the present state of Khandesh, it could not have been looked for.

Ahmednuggur stands second in superficial extent.[h] The land revenue is only inferior in amount to that of Dharwar, although it has the least number of cultivators[i] in all the collectorates. The average rent of farms therefore is the greatest ; and from averages struck in different

a 62,023 acres. b 839 rupees, 3 qr., 7 reas. c 44,608.

d 37 rupees, 1 qr., 33 reas.

e $\frac{\text{Beegahs } 883{,}448,}{\text{Cultivators } 37{,}311.} = 23{\cdot}68.$

f $\frac{\text{Rupees } 1{,}664{,}904}{\text{Beegahs } 1{,}056{,}345} = $ 1 ru. 2 qr. 30 rs. per beegah.

g Poona and Nuggur 3 qr. 58 reas per beegah, including garden-land. The whole of Dharwar 2 qr. 94 reas per beegah, including garden-land.

h 9910 square miles. i 41,948 cultivators.

villages in various parts of the Desh in this collectorate, I would refer it to the increased size of the farms rather than to enhanced assessments.

In a table, which will be met with in treating of the condition of the people, farms are made to average about 45 beegahs each; and the assessments, including extras, do not amount to a rupee per beegah.[a] In the hilly tracts the farms are necessarily much reduced in size, and an average for the whole collectorate would bring them down probably to 35 beegahs each; 41,948 cultivators therefore would occupy 1,468,180 beegahs of land, which, divided into the land revenue, (1,815,837 rupees,)[b] give 1 rupee, 95 reas per beegah. I am rather disposed to rely upon the general average, than upon the average struck from the examination of the papers of a few towns in the most favourable parts of the country.

The very low amount of the Sahyer, which is only 2·90 per cent. of the whole revenue, has been already adverted to. The taxable persons,[c] nevertheless, under this head, exceed those of Khandesh.

The customs bear a fair proportion to the whole revenue.

The average revenue[d] per village may be subject to a slight modification, as in the number of British villages, amounting to 1878½, furnished to me by the acting collector, which paid revenue last year, deserted villages are not distinguished, part of whose lands are under cultivation; and the want of population returns disables me from ascertaining them.

The revenue, viewed as a poll tax,[e] bears easier than in any other collectorate, excepting Dharwar. The means to insure an approximate accuracy in this calculation have been already explained.

Poona has the smallest land revenue, and the smallest superficial extent.[f] Previously to the addition of the four Talooks of Sholapoor, Mohol, Moodeebeehall, and Indee, agreeably to information furnished by the Survey Department, it comprised an area of 4990 square miles only. Neither the extent nor population of these Talooks being known, it was necessary to estimate them; the process was conducted by analogy, which has been explained elsewhere; 2888 square miles resulted from the calculations, giving the Poona collectorate an area of

a 2*s.* 8*d.* per acre.

b $\frac{\text{Rupees } 1{,}815{,}837}{\text{Beegahs } 1{,}468{,}180} = 1 \text{ rp. } 0 \text{ qr. } 95 \text{ rs. per beegah.}$

c 14,267.

d 1082 rupees, 2 qr. 99 reas.

e Revenue as a poll tax, 3 rupees, 3 qr. 77 reas.

f Area 7878 square miles.

7378 square miles. Poona has the greatest number of cultivators[a] excepting Dharwar; and this is to be attributed, not to the extended cultivation, but to the Mawul, or hilly tracts, occupying a great deal of the collectorate, where the farmers are multiplied and the individual agricultural operations of very limited extent. In the whole Turruff of Mhurkhoreh the farms average only 13 beegahs each; [b] but in the eastern and south-eastern parts of the collectorate they have the same average as is given to Ahmednuggur. From the above facts the farms might be expected to average a very low rent, as is found to be the case. The following estimate justifies the inference that the land assessments are comparatively not very onerous.

In the Desh, or Table Land, the farms average.......... 45 beegahs.
In the Mawuls, or hilly tracts........................ 13 do.

2)58

Mean average of farms......., 29 beegahs.

In 1827-28 there were 52,668 cultivators, which multiplied by 29, the average number of beegahs to each farmer, will give 1,527,372 beegahs of land under cultivation; and as the land revenue of 1827-28 amounted to 1,516,323 rupees, 37 reas; the assessments would only be at the rate of 3 qr. 97 reas per beegah,[c] including garden land and extras. There are still however some marked features which are not satisfactory: the villages average a greater revenue (excluding the city of Poona) than in the other collectorates, although the average village population is less for that part of the Poona collectorate, whence population returns have been received.

The 574 villages of the sub-collectorate of Sholapoor average 1272 rupees, 1 qr. 12 reas each,[d] including customs. The magnitude of the average of the remaining villages may be attributed to the great amount of the customs;[e] but deducting a suitable proportion of the customs[f] for the inhabitants of the city of Poona,[g] and the whole of the revenue of the city, Sahyer,[h] land,[i] and Abkauree,[k] and mint[l]; villages (always excluding the four talooks of Sholapoor) still average 1241 rupees, 1 qr. 76 reas each, which is higher than in any other collectorate; and as the

a 52,668. b $9\frac{3}{4}$ acres. c $\frac{\text{Rupees } 1,516,323}{\text{Beegahs } 1,527,372}$ = 3 qr. 97 reas per beegah.

d Revenue of sub-collectorate of Sholapoor 730,289 rupees, 1 qr. 93 reas.

e 215,361 rupees, 2 qr. $37\frac{1}{2}$ reas. f 61,756 rupees, 1 qr. 63 reas.

g 81,515 inhabitants. h 56,202 rupees, 3 qr. 50 reas.

i 27,981 rupees, $81\frac{1}{2}$ reas. k 12,000 rupees. l 3301 rupees.

villages in this part of the collectorate average a fraction more than 226 inhabitants,[a] the taxes, assessments, and customs,[b] after deducting the share for Poona, 151,241 rupees, fall upon the people with the unexampled pressure of nearly 5¼ rupees per head,[c] while the people in the city[d] average only one rupee, 3 qr. 41 reas per head, including a proportional share of the customs, and the city, Sahyer, and land-tax, &c.

For the whole collectorate of Poona, including the four talooks of Sholapoor, by a process previously explained, the assessments average 4 rupees, 1 qr. 73 reas per head, which closely approximates to that of Khandesh.

Poona has the greatest number of taxable persons[e] after Dharwar in the Sahyer branch of the revenue, and ranks second in the total amount of the sum raised, which falls with a less pressure individually than in Dharwar and Khandesh, but greater than in Ahmednuggur. The manufacturers, as contributors to the Sahyer, are very limited in number.

The proportion that the customs bear to the whole revenue is a very striking feature: they are derived principally from imports, a good part of which passes on to the eastward; much is consumed in the city of Poona, and the rest is dispersed into the districts. I have observed that imports from the coast have gradually cheapened in their retail price within the last three or four years, owing, no doubt, to the combined causes of increased importation and scarcity of money in Dukhun.

The collectorate of Dharwar, whether viewed with respect to the quantity of land under cultivation; the size of its farms;[f] the amounts of its revenue; the lightness with which it falls upon the people, considered as a poll-tax;[g] the magnitude of its Sahyer; the comparative denseness of its population; its numerous towns[h] and tolerably well-peopled villages; the facility offered for instruction in the number of its schools, and the manifestations of manufacturing industry in its numerous weavers,[i] is unquestionably the finest British province in Dukhun.

Dharwar Land Revenue.—The land revenue, in its proportion to the whole revenue, stands third in the Dukhun collectorates, being 80·336 per cent.; but this apparently inferior station is to be attributed, not to the diminished quantity of land under cultivati-

a 894½ villages with inhabitants, 202,252. b 1,110,470 rupees.

c 5 rupees. 1 qr. 96 reas,

d Inhabitants of Poona 81,315. Taxes and proportionate share of customs &c. 151,241 upees.

e 23,042. f 32·74 acres, or 43·65 beegahs. g 3 rupees, 1 qr. 60 reas.

h 119. i 13,345.

on,[a] which far exceeds that in the other collectorate, (i. e. 61·11 *decls* per cent. of the whole lands, leaving only 38·89 *decls.* per cent. of waste,) but to the lowness of its land assessments, amounting only to 2 qr. 94 reas per beegah, including all extras falling on the land. The process by which this average assessment was struck is as follows. In 1827, agreeably to the population returns, the land in occupation of a cultivator averaged 32·74 *decls.* acres, or 43·65 *decls.* beegahs; in 1828, in the Jummabundy settlement, there were 60,701 cultivators, which, multiplied by 43·65 *decls.* gives 2,649,598. 65 *decls.* beegahs of land under cultivation. These divided into the land revenue, 1,915,323 rupees, 2 qr. 8 reas, give 294 reas per beegah, a low rate, which neither the examination of village accounts, nor a similar process, will give in Poona, Ahmednuggur, nor Khandesh.[b] This light assessment, equal only to 1*s.* 11½*d.* per acre, is certainly advantageous in insuring the realization of the revenue; but when put into comparison with the rent of land in England, shows the unproductive and limited character of Indian agricultural resources.

The Sahyer branch of the revenue is highly favourable, amounting to nearly 14 per cent. of the whole, and, though so productive, falls as a tax lighter on individuals than in Khandesh. The customs, being 2 per cent. lower than in Khandesh and Ahmednuggur, is at variance with the tolerably efficient character of the general resources of the Dharwar.

From the examination of village papers I find that remissions were very rare under native governments, and the facility with which they are granted under the British government, and their magnitude, testify strongly to its paternal character. Great caution, however, is requisite in granting them, not less on account of the government than on account of the cultivator himself. If obtained with facility, and without rigid and sharp examinations, and some personal inconvenience to the applicant, (from the habitual indolence of the native character,) his ordinary industry, which always requires stimulating, would be paralyzed, applications multiplied, labour diminished, and the farmer would trust to the forbearance of government rather than to his own exertions. There is another reason for caution in the strong motives that the native agents have for urging remissions, with a view to intercept them in the transit of accounts through their hands.

The collector cannot possibly personally ascertain the truth of one-

a 2,308,064 acres in 1827.

b Ahmednuggur 1 rupee, 95 reas; Nuggur and Poona, partial average, 3 qr. 58 reas; Khandesh 1 rupee, 2 qr. 30 reas per beegah.

hundredth part of the claims set up; he must leave this labour to his servants, and it can scarcely be believed they will not avail themselves of the opportunity to turn the discretion given to them to private profit: in fact, I know such to be the case.

In an examination of the papers of the villages of Muhrkoreh, Poona collectorate, I found that many of the cultivators had paid instalments of their assessments (for 1827-28) previously to remissions being granted, which exceeded the amount they were required to pay after the deduction of the remissions; the poverty of some of the cultivators, consequently, must have been misrepresented. I ascertained also that part of the remissions of 1827-28 had been intercepted. Remissions are unavoidable in all calamitous visitations of Providence, which are not of confined or local operation, and which affect the returns of the earth; but to insure the benefit of the remissions to the cultivator, they should be made in a definite per centage on his total assessment, and the amount should be proclaimed more than once, and by different persons, in the public place of every village.

A few words in conclusion will suffice with respect to the great branches of the revenue. It is seen that 82·30 *decls.* per cent. of the whole is derived from the land: already the supply of agricultural produce exceeds the demand, and the farmer has a difficulty in finding a mart. In the present state of agriculture therefore, this branch of revenue is at its maximum, and will probably decline until supply and demand be adjusted.

The prospects of improvement in the Sahyer branch are not more favourable than in the land revenue.

The trades pay to the full extent of their means at present, and manufactures cannot increase when the European importers of cottons can afford to undersell the native manufacturers. Indeed I believe little more than coarse Sarhees[a] for women, and common tent cloth, are now manufactured in the British provinces in Dukhun.

The improvements in customs should usually depend upon increased wealth and commercial industry in the people. The extent of imports will only be commensurate with the means of purchase. If therefore the opinions I have advanced on the land revenue and Sahyer be well founded, with respect to the limited means of persons paying taxes under those heads, the customs will be influenced by causes affecting them.

a Dresses.

Any general improvement in the revenue would seem to require the creation of exportable articles in agriculture, horticulture, or manufactures ; and to effect this desirable object, the introduction of persons with capital, enterprize, ingenuity, commercial tact and industry, is necessary ; essentials, of which the country is at present destitute.

The manner in which the revenue yielded by a village is partitioned, is well exemplified in Neembawee, Pergunnah, Kurdeh, Ahmednuggur collectorate. The village is in Jagheer to Bala Sahib Rastia, one of the great Jagheerdars. The shares in the village are called amuls[a], and there are six of them; Rastia has three, Suchew [b] Punt one, and the Honourable Company two. The whole shares are considered as an integer of 123 parts.

Sun, 1236.—A. D. 1826.

Rastia has the Jagheer [c]	50	
Sur Deshmookee and Nuzzur[d]	23	
Kussur, [e] or remainder	7	
		80
Suchew Punt has the Sahotra	23	
		23
The Honourable Company has the Mokassa	15	
and the Neem Chowthaee, or half of the tribute called "Fourth"	5	
		20
Total		123

In addition, the fixed money rights on the village are—

	Rupees.
Sur Pateel Dabaree of Tellegaon	5
Kundeh Kurdehkur Deshmook	101
Amrut Row Joonurkur Deshpandeh	101

Besides the Pateel and Koolkurnee, Chowgulla, Bullooteh, who have their fees.

It would seem very desirable to abolish the above absurd verbal dis-

a Amul, "rule," "sway."

b Suchew, "friend," "minister;" one of the eight ministers of the Rajah of Sattara.

c A fief.

d Nazar, "sight," "look," a present made on introduction to a person.

e Kasr, "a fraction."

tinctions, and to fix the rights of individuals as simple money dues, without reference to Jagheer, Nuzzur, Kussur, &c.

The revenue of Dukhun, contrasted as a capitation tax, with that of England, France, and America, would appear to be as follows. In England, the gross revenue of 1828 was £50,700,000; poor-rates, parish rates, lighting, watching, £12,000,000; contributions of congregations to their clergy, colleges, schools, &c. about £17,300,000: total £80,000.000.[a] The population being 20,000,000, the tax per head is £4. In France, the taxation, including provision for the clergy, schools, &c. is £40,000,000; the population 30,000,000; equal therefore to £1. 6*s.* per head. In America the population is between 10,000,000 and 11,000,000, and the taxation £5,000,000, or not quite 10*s.* per head. The revenue of Dukhun, viewed as a capitation tax, is 8*s.* per head.

Assessments.

Assessments and land measurements are so intimately connected, that it would not answer any good purpose to treat of them in separate sections. With respect to the portions of land variously denominated for the purpose of assessment, I am clearly of opinion that the prevailing denominations amongst the Hindoos were not descriptive of superficial extent, and that the assessments were founded on the productive power of the land without reference to its quantity, and were uniform only for similar denominations of land in a village.

The Moosulmans, no doubt, endeavoured to be more systematic; they measured garden lands, and probably in some few villages, the field lands, under the denominations of Kundhee, Mun, Tukeh, Piceh, Seer, &c. with a view to the general conversion of such terms into the uniform and appreciable term of Beegah; but the Hindoo terms not applying to quantity, the beegahs of different villages could only be equal when there existed an accidental identity in productive power in the *unmeasured* Mun or Kundhee, &c. of land in one village with the *measured* Mun, Kundhee, &c. intended as common types. This will account for the varying extent of the beegah in field cultivation in Dukhun. How little successful the Moosulmans were in their attempt to supersede the old terms, is proved in the limited extent to which the assessments by beegahs obtained when we took possession of the country. It may be well doubted whether we shall be more successful in our introducti-

a Speech of Colonel Davies in the House of Commons, May 8, 1829.

on of acres : the ramifications of ancient usages amongst a people are in general too deeply fixed to be eradicated by legislative enactments. A plant may be cut off by the surface, but there is always a latent disposition to reproduction from the untouched roots. Whatever may be our success, a revenue survey was imperatively called for under the indefinite Hindoo land denominations, to enable a collector to regulate his assessments with a shadow of equity.

With respect to the denominations under which land is assessed in the comparatively limited space of my inquiries, their variety and absurdity demonstrate a wanton *bizarreness* that could scarcely have been looked for in a people reputedly simple and uniform in their opinions and economy. The assessment on a beegah is definite as it depended on positive measurement, and I have remarked that it obtains at, and in the neighbourhood of the established seats of Moosulman authority, as at Ahmednuggur, Purunda, Sholapoor, Mohol, Barlonee, Wamoree, Tacklee, &c. The Chahoor and Rookeh, as at Alkootee, Kheir, Wangee, Taimbournee, Kurkumb, Angur, Mahreh, Kurmalleh, Kurjut and Meerujgaon, being multiples of the beegah, are intelligible. Even the Doree or rope, used at Hungawarreh and Neembee, as it implies measurement and superficial extent, is admissible. The old Hindoo terms, Kundhee and Mun, at Ranjungaon, Jamgaon, Parnair, &c. &c. as they are founded on positive properties, furnish sufficiently precise ideas. But the Tukeh, with its constituents of Sujgunnees and Piceh, (copper coin,) at Dytna and Ankolner, the seer of weight and its Nowtanks or ⅛ Seer, as at Koorul and Wangee, and the Pyhnee and its Annas[a] at Serrolee, Bruhmunwarreh and Muhr, are not reducible by any operation of the mind to an appreciable portion of land, whose produce shall admit of the government share on it being equitably assessed. The assessment by the hatchet, rude as it is, still involves the idea of as much copse-wood land as one hatchet can clear, and one man can sow and reap in the year. To add to the confusion, similar denominations of land are not made up of common and uniform constituents. The Tukkeh at Kothoul is raised from the Rookeh, each of which is supposed to contain 10 beegahs, or 7½ acres. At Ankolner the Tukkeh is composed of Sujgunnees, Piceh and Rookeh; the Rookeh being equal only to 2½ beegahs, or 1⅞ acres. At Lakungaon there are 10 Tukkeh to one Pyhnee, and as the Pyhnee is said to contain 30 beegahs, the Tukkeh here contains only 3 beegahs instead of 480, as at Tellegaon; or 210, as at Ashtee.

[a] One-sixteenth of a rupee.

In respect to the Mun at Ranjungaon, it is rated at 10 beegahs; at Jamgaon, belonging to Seendeh, it is not reducible into beegahs at all; at Parnair 6¾ beegahs only are equal to the Mun. The Pylnee at Seerolee has the Chahoor of 120 beegahs as a typical standard, 4 Pylnees being equal to one Chahoor, or 120 beegahs; at Muhr the Pylnee of 30 beegahs is considered as identical with the Kundhee of 20 Muns, reducing the Mun therefore to 1½ beegahs.

Under such complex definitions and involved contradictions, my limits will not permit me to give further explanations, but which my lengthened tables afford.

The principal assessment necessarily falls on the land, and it is raised on the various land denominations above noticed; the land in the first instance being separated into the two great classes of Bhaghaeet, or garden-land; and Zerhaeet, or field-land. Both these terms are evidently of Moosulman introduction, Bhaghaeet being a word of Persian origin, meaning "gardens," "orchards;" and Zerhaeet, of Arabic derivation, meaning a "sown field," "sown land."

There are marked traces of the land assessment having once been systematic in the Sostee or permanent rate, which was uniform and unchangeable for all lands of the same denomination. This rate is found in most villages, it is distinctly stated in the accounts, and separated from subsequent and increased assessments, and its existence is a proof that assessments formerly were not on the superficial extent, but on the productive power of the soil; since, as lands were not all equally fertile, more of the unfertile land must have been held than of the fertile, to enable the cultivator to pay a fixed sum in quantity of grain for a piece of land under a common denomination. The *Sostee Dur*, or permanent assessment, was the pride of the Meerasdar, but unhappily not his safeguard. The various governments which have passed away do not appear ever to have *raised the permanent rate*, but they rendered the advantages derivable under it abortive from gradually adding extra cesses; their excuses in the first instance being unlooked-for contingencies. The cesses were originally mostly in kind, and temporary; but the exigencies of government, or the facility with which they were raised, made them perennial, and their pressure upon the cultivator has been enhanced, particularly under our government, by the cesses in kind being commuted into money payments. The Moosulmans, on introducing measurements, must necessarily have subverted the Sostee, or uniform rate, since the same rate could not have been equitable for beegahs of land of different qualities. We find, in consequence, that when the lands are classed in beegahs

otherwise than as constituents of Hindoo land denominations, that there the assessments are on the quality of the soil, and vary accordingly.

Gardens being dependent on the local advantages of a suitable supply of water and some depth of soil, usually met with in hollows or on the banks of rivers, it might be expected that considerable uniformity would prevail in the quality of garden-land, and that it would rarely be divided into classes; such is usually found to be the case. Most commonly all garden-land appertaining to a village pays the same rate per beegah; and where classification exists, it is founded, not on the quality of the land, but on the extent of the supply of water.

The first great feature, in this respect, is whether the garden is watered from small streams conducted from rivulets or rivers, or whether it is watered from wells; in the former case it is called Paatsthul,[a] and in the latter Mohtsthul.[b] Most Pahts failing in the dry months of March, April, and May, the former land is usually assessed at a lower rate than the latter, as at Tellegaon and Parnair; but where the Paht supply is perennial, as at Dytna, both descriptions of land pay the same rate. Dependent on these primary distinctions, are modifications, affecting garden assessments: land with a perennial and sufficient supply of water, whether from pahts or wells, is called Wohol-Waho, or fully watered, and pays the highest rate; this rate, unless on rice land, and isolated spots, where fruits of considerable value are raised, such as grapes and golden plantains, &c., as at Joonur, within my observation, has never exceeded 6 rupees per beegah,[c] including sugar-cane land. The other classes of land are comprised in the Kord Waho or not fully watered. It is readily intelligible that a well may supply a sufficiency of water for great part of a garden within a reasonable distance of the well, but that the extremities may be inadequately watered, and this affords just grounds to demand a lighter tax for the extremities: two classes should result from such circumstances, i. e. fully watered and not fully watered, and such is generally the case where distinctions are made at all: but at Ahmednuggur there is an affectation of discrimination, which has determined that garden-land receives its watering in the proportions of "fully," "thirteen-twentieths," "three-fifths," and "one-half," and such lands are respectively assessed at 5 rupees, 3¼ rupees, 3 rupees, and 2½ rupees per beegah. The assessment on garden-land at present is unequal, and the whole requires revision. There is every motive to make garden-cultivation assessments light with a view to insure to each cultivator,

a From Paat "a channel," and Sthul "a field."
b From Moht "a water-bucket," and Sthul a "field."
c 16*s.* 8*d.* per acre.

if possible, his well and little plot of garden ground. Gardens produce all the year round; they are comparatively unaffected by the droughts which destroy field crops; and independently of the constantly saleable garden stuffs, fruits, and aromatic seeds, there is usually room for a beegah or more of bukshee or johr wheats, which require watering, and a plot or two of sugar-cane. To his garden the cultivator is indebted for many of the little enjoyments his situation is susceptible of. In some instances, in the Mahloongeh Turruff, Poona collectorate, I found cultivators paying their entire assessments, and reaping profit by their garden produce of chillies[a] alone, which were sent into the Konkun.

Usually it has been deemed sufficient to arrange Zerhaeet or field-land into four classes, as at Jehoor, namely, Awul (best), usually black land, Rehsee (modified black), Burrud (dashed with lime and some decomposing greenstone), and finally, Khurrud (stony, thin, and poor). The first, throughout the country, does not average more than 1 rupee the beegah, the second $\frac{3}{4}$, the third $\frac{10}{16}$, and the last $\frac{8}{16}$ of a rupee per beegah; but at other places there are other distinctions. In the Mawuls, or hilly tracts along the Ghauts, lands are classed as Bhat, Khatan, and Wurkus, the first being rice land, the second wheat and grain land, and the third being on the slopes of hills, producing the dry grains Sawa[b] and Wuree;[c] there being a great deal of red soil also in these tracts, it is distinguished by the term Tambut or copper-coloured. The Awul, or best, where it occurs, is called Kalwut (black), and the rocky and stony Maal.

These explanations are sufficient to show that where assessments on the quality of the land have been introduced, uniformity has not obtained in distinguishing the qualities; they show also that the people were satisfied to limit the qualities to four gradations; but at Ahmednuggur, the Shaikdar or inspector of cultivation has had the microscopic ability of vision to mark twelve shades of difference in the field-land. The accounts are, in consequence, a mass of perplexity, and it is very probable the revenue is frittered away in distinctions which the cultivator never dreamt of, and never profits by.

Field-lands, on which the cultivators sink wells, are not assessed as garden-lands. At Kanoor, Nuggur collectorate, I found lands so circumstanced had been free from any extra assessments from a period beyond the memory of man.

a Capsicum annuum, and other species.

b Panicum frumentaceum. c Panicum miliare.

The above notices are sufficient to show the anomalous character of the money assessments strictly on the land. Not only are they arbitrarily fixed on the productive power of the land, or on measurements, real or supposed; but lands of the same denomination and quality are differently assessed in neighbouring villages without apparent cause.

The average of all the rates at many towns and villages in all parts of the country, derived from personal inspection of the village accounts, gives 3 rupees, 41 reas for a beegah of garden-land, or 8*s.* 3⅓*d.* for an English statute acre. The average of field-land is 3 qr. 93¾ reas per beegah, or 2*s.* 7½*d.* per English acre.

To determine an approximate average assessment per beegah in Khandesh, I may use elements, which although not just, may be expected to give results not very far from the truth; namely, the total number of beegahs of land under cultivation in the population returns in 1826, and the land revenue in 1827-28: the former is 883,548 beegahs, and the revenue 1,664,904 rupees: the average rate per beegah is 1 rupee, 3 qr. 54 reas, a much higher rate than exists in the other collectorates.

These assessments comparatively with those of all European countries, of most Asiatic countries, and relatively to the valuable nature of the garden produce, comprising, independently of the ordinary fruits and vegetables, grapes, oranges, sugar-cane, cotton, two kinds of fine wheat, and aromatic and pungent seeds,—the field produce also embracing all the bread grains, gram, and other pulses,—are unquestionably very low; and were there no extra cesses even in the present depreciated value of agricultural produce, could not only be borne by the cultivator, but he might flourish under them even with the burthen of 25 per cent. on his produce—fees paid to the Hukdars and Bullootehdars. These rates, however, are considerably enhanced by extra cesses called Puttees, many of which were levied for contingencies and particular exigencies, or resulted from the conversion of voluntary offerings in kind into compulsory money payments.

These cesses are no less than 62 in number in the three collectorates of Poona, Ahmednuggur, and Khandesh, and the whole of them are for different objects; many of them result from local circumstances, and are therefore of a local bearing. The majority of these Puttees are not of uniform operation in the three collectorates, but one or more of them up to a score may be found in every village.

A few observations on the origin, character, and practical effects of some of these Puttees may be necessary. Most of them profess to bear directly on the land, such as those for grain, forage, and ropes to govern-

ment, grain to Ramooses, Havildar, Gosawees, and Meeras tax, tax for sugar, &c.: other taxes which originally fell upon trades people, such as those for skins, shoes, wool, blankets, and oil, are no longer derived from their legitimate sources, but fall upon the cultivator. Milch cattle, fowls, mango trees, and pumpkin beds respectively continue to supply the means to pay the taxes for Ghee, thickened sour milk, fowls, and fruits. Some of the Puttees involved personal labour, such as those for grass cut and furnished gratis to government, for firewood, for dinner plates composed of leaves sewn together, for monsoon great coats made of wicker work and leaves, and for sticks to pound rice with. The Rabta Mahr, spoken of under "tenures," is in lieu of personal services. Some of them in their name indicate their professedly temporary character, such as the Eksalee, or for one year, and yet they have been perpetuated. The Shadee or marriage cess at Angur, Pergunnah Mohol, and Ashtee Pergunnah Oondurgaon, amounted to nearly 12 per cent. of the whole revenue of the towns, and could only have been for a passing event. The Wurgut at Wangee and Ashtee, which was raised by the village authorities for village expenses, is one of these unjustifiable taxes. At Ashtee, the scene of the battle of Ashtee and capture of the Sattarah princes, in 1818, the Wurgut was 1405 rupees, in a revenue of 6366 rupees, or 22 per cent.; of this sum government took 900 rupees, leaving 505 rupees to the villagers for their expenses. This Puttee at the town of Kurjut, Pergunnah Kurreh Wullet, is 6 annas per rupee, or 37½ per cent. on the land and Sahyer assessments, and Burgoojur or tax on betel gardens. At Rawgaon, the Wurgut amounted to 14½ annas per rupee on the land assessments and taxes, or more than 90 per cent. The Kaateh Mornawul, or pecuniary punishment, inflicted on a village for a Mamlehdar's running thorns into his feet on perambulating its lands, should have had some limits in its duration. The Puttees for sturdy Gosawees, Havildars, Ramooses, Naikwarees, should have ceased when there were no longer Gosawees to beg with arms in their hands, or Havildars, Naiks, and Ramooses to exercise respectively certain functions.

The fractional apportioning the above taxes to the cultivators, involving also the compound operation of providing reduced shares for the privileged classes, the fractional deductions, in a certain ratio in case of remissions, the fluctuating amount of the individual shares dependent on the fixed commutation cesses, being yearly divisible amongst a variable number of cultivators, the mutable character of the Seerusteh Butta, which necessarily changes with the yearly varying total assessments of the village, and which Seerusteh Butta is not determinable until all other assessments be fixed, combine great

evils, and, unless to the most practised, patient, and persevering investigator, present an inextricable mass of confusion. The evils are, that a cultivator, be he lettered or not, cannot by possibility know what he will have to pay the ensuing or even the present year, because fixed sums, payable by the village, are divisible amongst a varying number of cultivators. Even if fixed sums were divisible amongst a fixed number of cultivators, the limited progress in arithmetic of the poor people would utterly disable them from determining their respective fractional shares; for instance, of 4 rupees for skins and shoes, 1 rupee for beit,[a] $4\frac{3}{4}$ for ghee, and $1\frac{5}{16}$ for leaf plates, &c. &c. In the whole course of my personal inquiries amongst this class for more than six years, I never met with one Koonbee who could or would give me a detail of his assessments or their amount; the constant reply was, "The Koolkurnee knows." This very uncertainty of their means and liabilities makes men improvident and careless.

The next evil is, that the Koolkurnee, in apportioning the fixed sums, and the Seerusteh Butta, the commutation money for grain, for ghee, sugar, pumpkins, &c. &c. is assured of impunity in defrauding the cultivators, from their want of ability in their accounts, even if they were aware of the value and amount of the cesses and the number of persons they were to bear upon. It is almost waste of labour to give the cultivator a note from government of what he will have to pay, as in nine instances out of ten he cannot read it; his expounder is the Koolkurnee, or the Koolkurnee's relations, and they read it agreeably to their own calculations.

The above is an exposition of the assessments as they now bear on the land, which produces 82·30 per cent. of the whole revenue. The remaining portions of the revenue, which appear in village papers are usually classed under the term Sahyer, and are in fact taxes. The two principal heads of Sahyer are Mohturfa, properly "Arhan," or taxes on shops, houses, and professions; and Bullooteh.

Operation of Sahyer Taxes.—An idea of the operation of these taxes will be formed by the following details from Wangee, Pergunnah Wangee.

Wanees, or sellers of grain and groceries, from 4 to 6 rupees a shop; oilman, for one oil-mill in work.............. 6 rupees.
Weavers, per loom.. 3 do.

Other tradesmen pay proportional taxes. The threshold tax is called

a Beit, "a present."

Oombraputtee, from Oombra, threshold: it is generally a rupee per house.

At Tellegaon, Pergunnah Paubul, Poona collectorate, the taxes on trades are fixed on a scale of annas relatively to the visible means and profits of the tradespeople. The anna is considered equivalent to 3½ rupees. The trades are taxed from ¼th anna to 2 annas, or 7 rupees, which is the highest sum for one shop.

The highest tax on one weaver is half an anna, or 1¾ rupee; oilman, highest rate one anna, or 3½ rupees; the saddler, dyer, and butcher, at half an anna each, or 1¾ rupee: fishermen, dealers in sweet potatoes, and makers of bridles, 1 rupee each; the *community* of braziers, 10 rupees. All the Momeens who are Moosulmans and weavers of turbands taxed in the lump at 25 rupees; shepherds at 14 rupees. These taxes are not raised on any systematic principles of application.

Bullooteh Tax.—The Bullooteh is a tax levied on the persons called the Bara Bullooteh, or artizans and functionaries twelve in number, who are important personages in the village constitution.

The taxes on the Bullooteh are generally deemed to be on the exercise of their profession; but this is a mistake, as the astrologer and Guruw, or sweeper of the village temple, pay Bullooteh tax, although not artizans; and I have known individuals of a trade (in one instance a boy the survivor of a family) paying from 20 to 25 rupees per annum, which they could not possibly do from the gain of their handicrafts.

The fact is, the Bara Bullooteeh have annual grain fees from the cultivators; and government, in former times, deeming these fees more than commensurate with the value of the labours performed, took a part of them in money. The taxes on the Bullootehdar, are therefore indirectly derived from the land; some of these taxes fall very heavily. At Wangee three carpenters pay 36 rupees Bullooteh tax, Wurgut 9 rupees, and house tax 3 rupees for three houses. At Tellegaon, Turruff, Paubul, the Bullooteh taxes are yet higher: carpenter 50 rupees, shoe-makers 60 rupees, Guruw or sweeper of the temple 30 rupees, barber 24 rupees, washerman 8 rupees, Moolana, or Moosulman priest, who also gets Bullooteh, 8 rupees; but the cultivators are numerous, and the lands of Tellegaon under cultivation extensive. The Bullootehdar on the whole therefore reaps a rich harvest, in spite of government participating in his fees, from the cultivators. It is unnecessary to multiply instances of the bearing of the Sahyer taxes. Taxes for the sale of spirituous liquors, and the amount of customs or transit duties, rarely appear in village papers, as those branches of the revenue are mostly farmed.

My limits do not permit me to give a detailed statement of the manner in which village accounts are kept under a native government. It would much assist to illustrate the internal œconomy of a village and many local usages, but I have not space. I can only say that the whole accounts of a village are kept on a ribbon of paper, about five inches wide and some yards long, not rolled up but folded in lengths of twelve inches or more: one of these is required for each year. At Wangee it is called *Gao Jarah*, or village search; at Kurmulla *Jhartee Akaar*, or figures or signs of search; at Barlonee it has the compound term of *Lownee Putruck*, (detail of cultivation,) and *Zumeen Jarha*, (land search); at Rawgaon it is called *Wussool Jarha*, or search of collections: occasionally it is *Akaarbund*, or roll of signs, items, figures. These varying names result from the union of two papers which are usually kept separate: namely the *Thul Jarha*, or roll of lands by family estates; and the *Lownee Putruck*, or roll of cultivation and assessments.

In closing the notice of assessments, a few words are necessary to explain the method of keeping village accounts. At the head of the paper called *Gao Jarha* is the name of the village, the Pergunnah and Soobeh it is in, the year and the name of the government it is under; this is followed by the Tunkha or Moghul money assignment upon the village, the Moosulmans having fixed each village to pay a definite sum, leaving the whole details of assessment and distribution to the Pateel and villagers; then follows the total quantity of land belonging to the village: deductions are made for land in boundary disputes, for Eenams of all kinds, whether to the temples, to the village officers, to the Deshmook or Deshpandeh, or to individuals, the quantity to each being carefully marked; all these being deducted, the remainder is distinguished into garden and field-land; then follows a roll of the cultivators, with a number of columns to record the quantity of land held upon each tenure, and the amount payable for each; a column for the share of the extra assessments, previously noticed, including the share of village expenses, which is always considerable; also columns for totals of the different heads. Then follow rolls of the Bullooteh, shopkeepers, trades, and others subject to fixed taxes, with columns for the proportion of tax upon the particular trade; the Bullooteh, the house-tax, and share of extra assessments, which these people pay although they are not landholders.

An abstract of the preceding details is now made, called the *Ekunder Tereej*. The contract for the transit duties, if not farmed, is added; and the *Kumall*, which means "total," "all," "whole," is put at the bottom. Then follow the deductions under the heads of money—Eenams, Hukdars, village, and other expenses, every item of which is detailed.

Amongst the expenses are village festivals, dinners to government officers, donations to brahmans, feeding pilgrims, interest on money borrowed, expenses of the Pateel and village officers when attending the governor of the district, oil in the temples, the Moosulman saint's tomb (if there be one) coming in for its share of donation or annual allowance, strange as it may appear, from Hindoo cultivators. I regret much that my limits do not permit me to detail the expenses, many of which are very curious, and illustrate habits and customs. The expenses being deducted from the collections, a balance is struck, which, under native governments, *left* the Tunkha, or government original assignment, together with any extra assessment, if levied, such as Sur Deshmookee, Chouth, &c. &c. To show how large a proportion of the village collections did not go to government, in one village, whose accounts I translated, the Tunkha, or government share, was 5500 rupees: and the Kumall, or total collections, 8522 rupees; so that 3022 rupees, or more than 35 per cent. of the whole, went in village expenses, Hukdars, (Deshmooks and Deshpandehs,) and other claims.

Wages.

The amount of wages of agricultural labourers is of so much importance to the class constituting the major part of the community, and it assists the judgment so materially in estimating the condition of the people, that I shall offer all the details I was able to collect in the Dukhun bearing on the question.

Farmers' Artificers' Work executed for Fees in Kind.—The trifling artificers' and mechanics' work required by the farmer being performed by the village artisans, in virtue of their offices and for fees in kind, it will not be necessary to enlarge on the remuneration for their labour: but to afford distinct ideas of its value, at the end of this paper I shall put into juxtaposition the rates paid by the Peshwah's government and the British government to artificers, mechanics, and others.

I made my inquiries on the subject of wages in towns and villages, the most distant from each other, to prevent the mistake of the adoption of local rates for those of general operation.

Wages of Husbandmen and other Labourers at Nandoor.—At Nandoor, a British town in the Ahmednuggur collectorate, in March, 1827, I found that yearly husbandry servants got from 12 to 20 rupees[a] per annum and their food; a smart active man got about 15 rupees per annum and supplied himself with clothes.

a From 24 to 40 shillings.

Day labourers, when paid in cash, get $1\frac{1}{2}$ anna per day, or $\frac{3}{32}$ of two shillings, (about two pence farthing,) supplying themselves with every thing: but day labourers are never paid in money unles when grain is very dear.

Quantity given.—The most usual plan in harvesting crops is to give each labourer three sheaves of whatever grain he is cutting down; and provided he ties up the sheaves and stacks them, he gets five sheaves a day.

Value of Wages in Kind, converted into Money.—The grain in five sheaves, in ordinary seasons, amounts to about two seers. At the price of Bajree*, in March 1827, at Nandoor, namely 42 seers per rupee, the value of the labour was one penny and $\frac{14}{100}$ths per day. Joaree†, at 56 seers per rupee, was $\frac{85}{100}$ths of a penny per day, or rather more than three farthings. Wheat, at 18 seers per rupee, would have been two pence $\frac{66}{100}$, or something less than two pence three farthings per day. Allowing the grain in five bundles to be double the quantity stated, which is rather possible than probable, the highest wages in harvesting wheat would not have been five pence halfpenny per diem. When men are employed in ploughing or harrowing, nine times out of ten, they are paid two seers of Bajree for their day's work, from daylight to night, allowing one hour for dinner.

At Kanoor.—At Kanoor, a town in Jagheer, Ahmednuggur collectorate, in March 1827, I found that the two Pateels had each a permanent domestic servant in his employ; one paid his man 15 rupees per annum and his food; the other gave 15 rupees per annum, food, and five articles of wearing apparel, the value of which was $3\frac{1}{2}$ rupees.

Wages at Dywuree.—At Dywuree, Nuggur collectorate, in November 1826, the cultivators did not pay their day-labourers in money, but gave them five sheaves of grain for every hundred cut down; a very able man indeed might cut down two hundred sheaves in a day, which would give him four seers of grain, the value of which (Bajree) in November, 1826, was about $\frac{2}{16}$ths of a rupee, or three pence English.

Wages at Dytna.—At Dytna, Nuggur collectorate, in February 1827, I found a man getting 25 rupees per annum, his food and a blanket, his son being also in employ at six rupees a year, food and clothes; but this was looked upon as high, and the individuals getting such wages fortunate: the village belonged to a Gosawee ‡ who paid his people well.

Wages of Women Day Labourers.—At Chambergoondeh, a large town belonging to Seendeh, Nuggur collectorate, in November 1827, women

* Properly, Sujgooreh, *Panicum spicatum.*

† Properly, Jondleh, *Andropogon Sorghum.*

‡ Gosawee, *a religieux.*

weeding in fields got $\frac{1}{16}$th of a rupee per day, or one penny halfpenny, and worked from sunrise to sunset.

Wages at Kurkumb.—At Kurkumb, a Jagheer town in the Poona collectorate, in December 1827, I found a husbandry servant getting only twelve rupees per annum, and food twice a day: no clothes. A man watching a field of grain was a monthly servant at three rupees a month, without food or clothes.

Highest Wages at Kurkumb.—From the authorities of the town I learned that the highest rate paid for the cleverest gardener's assistant or ploughman was 25 rupees per annum and daily food, but without clothes. The monthly rates for agricultural servants were from $2\frac{3}{4}$ to 3 rupees, without food, or clothes, fee, or advantage.

Pay of Seypoys at Angur.—At Angur, a British town in the Poona collectorate, on the 9th of January, 1828, in looking over the village accounts, I found two village seypoys charged respectively three rupees and two rupees for a month's pay.

Wages of Women Labourers at Poona.—On the 21st July, 1827, I found a great number of women weeding in gardens in the neighbourhood of the city of Poona; they received each six pice in money, or $\frac{6}{64}$ths of two shillings, (two pence one-third per day,) and worked from daylight until dark. This may be considered high wages, and its amount is to be attributed to the paucity of field labourers in a great city.

Wages at Pait.—At Pait, a Jagheer town in Pergunnah Kheir, in the Poona collectorate, on the 16th February, 1829, in my evening excursion, I overtook twelve or fourteen men and women with bundles of wheat in the straw on their heads; on inquiry I found they had been employed as labourers in *pulling up* a field of wheat at Pait. Their wages had been five sheaves for every hundred gathered; two or three of the men only had got five sheaves each, the majority of them only four, and the women none more than three. Five sheaves they said would yield about four seers of wheat, and as wheat was selling in Pait at 28 seers per rupee, each man with five sheaves received for his labour nine pice, or $3\frac{1}{2}d$. English. These poor people belonged to the town of Owsuree, five miles distant from Pait; they had therefore a march of ten miles to make besides their day's labour.

Wages at Joonur.—At the city of Joonur, at the end of February 1829, I found a brahman cultivating the Hubbus Baugh (about 80 beegahs of land); he employed numerous labourers. While I was encamped near his garden, fields of wheat, and gram, and Booee Moong*, &c. were harvest-

* Earth-nut, *Arachis hypogea.*

ed. For the wheat and gram and bread-grains the men got five sheaves per cent. In the field of Booee Moong there were between fifty and sixty women employed; and I learned that, in this particular product, from the labour and tediousness of digging it up, and the cheapness of the produce, the labourers were allowed one-fourth of the whole. In cutting down sugar-cane, gathering fruits or vegetables, and indeed where the produce was too valuable to give the labourer a share of it, the Brahman paid a man eight pice a day (little more than $2\frac{1}{2}$*d.*) and a woman four, and they worked from daylight until dark, with an allowance of one hour for dinner.

The above data are gathered from places widely separated in the Poona and Ahmednuggur collectorates; and although in different years, are remarkable in their uniformity; they supply therefore just estimates for the general rates of wages, and it may be fairly stated that the highest money wages paid by the natives to any husbandry or domestic servant is four rupees per month, with which he finds his own food and clothes, and $2\frac{1}{12}$ rupees per month is the pay when the master supplies food and clothes; and the most favourable wages to a man day-labourer are eight pice per diem*, and to a woman five pice†.

Artificers' and servants' wages, and price of Bread-grains under the Peshwa's and British Governments.

Rates of hire for a month of thirty days of artificers, servants, and labourers in Dukhun, under the British government in 1828, and Peshwa's government in A. D. 1814.			Prices of grains, pulses, and other articles, the ordinary consumption of artificers, servants, labourers, &c. at Poona in Dukhun, under the Peshwa's government, being a mean of five years from 1811 to 1815, and under the British in 1828.		
Denomination of artificers, servants, &c.	Monthly Pay. Under the British.	Monthly Pay. Under the Peshwa	Grains, pulses, and other articles	Seers per Rupee. Under the British, 1828.	Seers per Rupee. Under the Peshwa, 1814.
	Rupees.	Rupees.		Seers.	Seers.
Maistry, or head carpenter	25, 35, 40	15	Rice, Putnee	16	12
			Do. Ambemor ..	13	$9\frac{1}{2}$
Second or under do.	23 & 25	12	Do. Rajawul....	14	12
Maistry, or head carpenter, finest worker........	30, 35, & 45	15, 20, 40	Wheat, Buckshee	18	$14\frac{1}{2}\frac{4}{2}$
			Do. Potee	20	..
			Joaree (*Andropogon Sorghum*):	32	$21\frac{1}{3}$

* About $2\frac{3}{4}$d.

† About $1\frac{3}{4}$*d.*

Table continued.

Denomination of artificers, servants, &c.	Monthly Pay. Under the British.	Monthly Pay. Under the Peshwa.	Grains, pulses, and other articles.	Seers per Rupee. Under the British, 1828.	Seers per Rupee. Under the Peshwa, 1814.
	Rupees.	Rupees.		Srs	Seers.
Carpenter, common worker ..	15 & $22\frac{1}{2}$	12	Bajree (*Panicum spicatum*)	28	$17\frac{62}{200}$
Two Sawyers	15 & 22	8	Dhall (*Cytisus cajan*)........	16	$11\frac{86}{100}$
Maistry, or head smith....	25 & 30	20	Ghee (clarified butter)	2	$1\frac{1}{2}$ to $1\frac{3}{4}$
Smith	15 & $22\frac{1}{2}$	12			
Head armourer....	30	20			
Armourer	15	12			
Fileman....... ..	15	12			
Hammerman	6, 8, & $13\frac{1}{2}$	$7\frac{1}{2}$			
Maistry, or head leather worker	15	12			
Leather worker, harness maker	$9\frac{3}{4}$	9			
Puckalee, or waterman	15	9			
Bricklayer	$9\frac{3}{4}$, 12	10			
Head bricklayer, maistry	25 & 35	15 & 20			
Maistry, or head tailor, fine worker	15	14			
Tailor	$9\frac{3}{4}$	6			
Man labourer	5 & 7	5			
Woman do.	$3\frac{3}{4}$ to 7	3 to 4			
Boy do.	$3\frac{3}{4}$	3			
Muccadum, or chief of Dooly bearers.	15 & 20	8			
Dooly bearers	7 to 9	6			
Horse keepers	8	5	Served two horses	under Peshwa.	
Camel men	7 to 9	5	Served two camels	Do.	
Tattoo, or pack pony per month, with driver	12	15			
Camel with driver.	30	30			
Puturwut stone-mason	..	12			
Bhooee Hamalls..	7, 8, & 9	6, 7, & 8			
Muccadum, or chief of Hamalls	15	10			

The above table shows a marked enhancement in the wages of all classes of handicrafts and servants, although grain became from 20 to 50 per cent. cheaper under the British than under the Peshwa. In the wages of the numerous servants of European gentlemen the same advance has taken place. The superior cheapness in some grains has extended to more than 100 per cent.

In the above notices the rupee has been considered equal to two shillings; the seer of weight equal to 1 lb. 15 oz. 8 drs. 18¾ grs. avoirdupois, or 2 lbs. 4 oz. 6 grs. troy; and the seer of capacity to 2lbs. 6 oz. 3 drs. 24 grs. 92 dec. avoirdupois of Jerwail rice; its cubic contents, 72 in. 2 dec. of water at a temperature of 75° Fahrenheit, at a temperature of 60° therefore being equal to 48 per cent. less than two imperial quarts, or very nearly one quart. Rigidly, the seer is 4·17 dec. per cent. larger than an imperial quart.

Manufactures.

Celebrated as was India for its costly and ingenious cotton fabrics, little more than the memory of them now remains. The machinery of England has enabled her manufacturers to take the raw material out of the hands of the grower, and return it to the continent of India, worked up in various ways, without even affording an opportunity for the application of a prop or stay to the sinking industry of its once flourishing manufacturing classes. As far as relates to Dukhun, its cotton and silk fabrics are confined to coarse dresses for women, tent-cloths, some silk handkerchiefs, and trifling pieces of silk for bosom cloths for women. From an examination of the cotton and silk goods for sale in the markets of Poona, in July 1829, it appeared that every product of the loom, without any exception, with any claim to notice from texture, costliness of material, or ingenuity in the design or workmanship, was an import into the collectorates from native states not under the British government. Turband cloths, varying in length from 24 to 60 cubits, in breadth from three-quarters to 1½ cubits, and in price from one rupee up to sixty rupees each, were from Peytun, Bheer, Narrainpait, Tahr Putruh, Wuswunt, Nandergaon, and Shaghur, in the Nizam's dominions; Boorhanpoor and Jehanabad, in Seendeh's (Scindiah's) dominions, and Chundaree in Malwa, while those made in the city of Poona did not exceed three rupees each in value. The only valuable *Dotruhs* or loin cloths, in length from 20 to 22 cubits, breadth 2½ to 2¾ cubits, and in price from 10 to 40 rupees, were from Muheshwur, in Malwa; the rest were from the Nizam's, Holkar's, and the Rajah of Berar's (Nagpoor) territories. Shahpoor and Belgaon, in the Dharwar collectorate, produced some loin cloths of the value of 25 rupees; those from Poona did not exceed three rupees in value. The *Dooputtehs* or *Shelehs*, cloths for throwing over the shoulder and enfolding the body, in value from 10 to 200 rupees, were from Peytun, Jehanabad, and Boorhanpoor; those from Poona were of the value of five rupees only.

Loogreh or Sarhehs*, varying in length from 13 to 20 cubits, in breadth from 1¼ to 2¼ cubits, and in price from 1½ rupee to 80 rupees, had a wider field of production, even Poona producing these dresses, from one or two looms only I believe, of the value of 80 rupees. New Hooblee, and Shahpoor, in the Dharwar collectorate, produced some dresses of the value of 30 rupees. *Cholkun* or bosom cloths are manufactured at the above places: the highest value of one would appear to be 10 rupees, and the lowest about three-pence. The silk handkerchiefs were chiefly from the Carnatic.

The price of the above articles is influenced partly by the colours, partly by the fineness of the fabric, but chiefly by the quantity of gold and silver thread worked up in them.

Some cotton carpets are manufactured at Ahmednuggur, and in the Jail at Poona, but do not call for notice.

Turbands are dyed of twenty-one colours, but I have not space to give the names: few or none of them are fast colours, with the exception of black and red.

The only woollen manufacture in the collectorates is that of a black smooth blanket, *(Kumlee)* the colour being that of the wool. In general the blanket is coarse, but there is a very fine fabric from Bijapoor. The low state of manufactures is otherwise attested by the fact that, in the Poona collectorate, in the population returns sent to me, the weavers only amounted to 0·35 per cent. of the people, or one weaver for every 280 souls; in Khandesh 0·57 per cent., or one to every 173 inhabitants; and in Dharwar 1·80 per cent., or one in 55 inhabitants, which is prodigiously above the other collectorates. I *estimate* the proportion in the Ahmednuggur collectorate to be the same as that in Poona.

Transit Duties.

The transit duties are farmed; the stations for collecting them are numerous; the rates, although fixed, are unjust, as they are not levied on uniform principles with respect to definite tracts of country. The Carrier is not only interrupted at irregular intervals by British stations, but the alienated towns, so numerously interspersed in the British territories, endeavour to levy duties; moreover, he is perplexed by the money claims of hereditary district officers upon the duties, independently of the customs-farmer's dues. How the conflicting interests are arranged I do not know; but they are so various and troublesome, that the merchant is commonly driven to the expensive necessity of contracting with

* Women's dresses.

a class of people, called *Hoondeekuree*, who undertake for a *fixed sum* to pass all the merchandize through a country to its destination, paying all duties; constant practice, adroitness, and bullying, enabling them to arrange with the collectors better than the merchant could.

All transit duties should be abolished; their amount in the interior of a country materially affects consumption, and is therefore injurious to trade.

Coins.

The only coins in use in Dukhun are silver rupees, half rupees, and copper pice. The rupees are of many mints, and have a different value in relation to the copper coin, resulting from the age of the rupee, and the number of punches or marks it may have on it made by the Shroofs or money-changers in passing through their hands*; the same rupee, of the same standard, and same mint, has not the same value *in copper* in neighbouring districts; this value fluctuates at the pleasure of the money-changers. On what principles they regulate the relative values I do not know. The multiplicity of coins of different mints, and the gradations of coins of the same mint, are great evils. It is unnecessary to enumerate these coins, as they are in the Bombay Almanac.

Weights and Measures.

A very considerable diversity prevails in every district, and often in neighbouring villages, in the weights and measures in use, whether of weight, length, or capacity: this diversity goes so far, that the subdivisions are often found not to be in a determinate proportion to each other. All this confusion is referrible to the want of an ancient permanent standard: to the abrasion or decay of the weights and measures tolerated by government, the knavery of the owners of the weights, and the apathy or connivance of the district authorities †. Everywhere the apparatus of metrology is characterized by clumsiness in construction: rough stones are commonly substituted for stamped metal weights, and joints of the hollow bamboo for authorized definite measures of capacity. The seer of weight was directed by the authorities at Poona and Ahmednuggur to be of eighty Ankoosee rupees, and such a weight may be in use where the district officers are located, but in very few other places. With respect to measures of capacity, not only has each village its own, but I might almost say that each shopkeeper has his own, for it is rare that the weights and measures of any two shopkeep-

* These marks occasion a depreciation of one or more per cent.

† So great are the discrepancies, that they range from 41 per cent. below to 100 per cent. above the Poona standard.

ers are identical; and when it does occur it must be referred to accident. Even the stamping of weights and measures by government officers has not been effectual to insure uniformity; for in a table that I drew up of the discrepancy between the weights and measures of some scores of places all over the country, very many of the weights and measures had the government stamp upon them.

One feature of the measures of capacity is, that, with some exceptions, those of villages are always larger than those of towns and cities. The extent to which this fraud has been carried in military cantonments and large bazaars immediately under British control, is shown in the fact of the reduction of the Serroor cantonment seer, one-twentieth below the standard of Poona city, one-fourth below the standard of Ahmednuggur city, and two-elevenths below the measures of neighbouring districts. But in Bombay it is still more glaring, the origin of whose weights and measures is unquestionably referrible to the Dukhun and Konkun; and yet the Bombay measure of capacity is 41 per cent. less than that of Poona, and about 33 per cent. less than that at Panwell in the Konkun, the nearest great mart to Bombay on the continent The diminution in the seer of weight in Bombay is even more striking. I found the standard seer of weight in the collector's office in Bombay to weigh 4970 grains troy only, while the Panwell seer weighed 13,110 grains, and the Poona seer weighed 13,800 grains, troy. The Panwell seer therefore was 163 per cent. and the Poona seer 177 per cent. larger than the Bombay seer. The knowledge of these facts is of importance to the European and native merchant, as well as to the general consumer.

The evil of a progressive diminution in the weights and measures of Dukhun is arrested in the cities of Poona and Ahmednuggur and the neighbouring cantonments, by standards being kept in the collectors' offices; but as they are not founded on any scientific principles by which they could be restored if lost or *lessened*, their safe custody is of great moment. The seer of weight is directed to be made of a certain number of pieces of the current silver coin, and can therefore be tested without difficulty; but there is not any test, saving the solitary standard in the collector's office, for the measure of capacity. It will be seen that I have given the weight of water of a certain temperature these measures contain, and this determination may be of use at a future period.

Grain measures.—The largest measure of capacity in use is the *Adholee*, of two seers; its name means "the half," it being the half of the *Puheelee*, of four seers, which is not in use. This measure is in the form of an hour-glass. I found the *Poona city* standard to contain 36,400 grains troy, of water, at a temperature of 75° Fahr., or 5 lbs. 3 oz. 3 dr. 5½ grs., or 144·4 cubic inches; and at a temperature of 60.

Fahr. it contained 36,462 grains troy, being 48 per cent. less than an imperial gallon, or very nearly two quarts; rigidly, the seer is 4·17 per cent. larger than an imperial quart. It is curious that the first subdivision of the *Adholee* is not one-half but one-fourth, or half a seer, a seer measure being very rarely in use; then a quarter of a seer, and finally, one-eighth.* In some places there are what are called male and female *Adholees*, one being a little larger than the other; retail traders buy with the largest and sell by the smallest. The multiples are 2 *Adholees* 1 *Puheelee* or 4 seers, 12 *Puheelees* 1 *Mun* (Maund), and 20 *Muns* 1 *Kundee* (Candy); but in some places there are 16 *Puheelees* to the *Mun*: and along the Ghâts, and in the Konkun, there are only 3½ seers to the *Puheelee*. Determined by the weight of the contents of the *Adholee* of well-dried Jerwail rice, the *Kundee* would be 20 cwt. 1 qr. 26 lbs. 10 oz. 12 drs. 16 grs. avoirdupois.

It is necessary to mention that the *four* of *all grains* is sold by weight and not by measure.

Oil, spirits, and milk, are sold by different measures of capacity. These are all professedly founded on the seer of weight; but their discrepancies may well render it doubtful. At one place I found the seer of oil measure to contain 26 rupees' weight of water, at others, 66 rupees', 80 rupees', &c. The forms of these measures are various. The same observations apply to spirit measures. The seer of milk in one place contained 88 rupees' weight of water, in another 93, and elsewhere up to 109 rupees' weight.

Weights.—The standard seer of weight in Poona weighs 80 Ankoosee rupees or 13,800 grains troy, or 1 lb. 15 oz. 8 dwts. 18¾ grs. avoirdupois; but the most common seer in use in Dukhun is one of 76 rupees; the divisions are *Adh seer* (half), *Pao seer* (quarter), *Adh pao* or *Nowtank* (one-eighth), and *Chettank* (one-sixteenth). For the convenience of calculation, the seer is divided into 72 *tanks* or *tollahs*, and one-eighth, of course, is *Nowtank* or nine tanks, and one-sixteenth is *Sarhee chartank* or 4½ tanks, which is corrupted into *Chettank*. The multiples are *Panch seer* (five seers), the *mun* of 40 seers equal to 78 lbs. 13 oz. 11 drs. 11 grs. avoirdupois, or 95 lb. 10 oz. troy exactly; the *Pullah* of 3 *muns*, and the *Kundee* of 20 *muns*. But I have shown how far the weights really in use differed from the above, and in the tract lying between the Seena and Beema rivers, the weight called the *Bureedee* had not even the same constituents or multiples as the Poona weights.

* Sellers of sweetmeats have 1-16th of a seer.

Goldsmiths' weights.—The lowest goldsmiths' weight is nominally the mustard seed, but the lowest I met with was the *Goonj*, a seed of the *Abrus precatorius*, the mean weight of which was 1·91410 grains troy: 96 *goonj* make a *tollah*, which should therefore weigh 183·7536 grains troy; but as the *tollah* is the 72d part of a seer of 13,800 grains, it should weigh 191,666 grains troy; the goldsmiths' weights in use consequently are below the nominal standard. Eight *goonj* or four *waals** make one *massah*, and twelve *massah* one *tollah*. I put the goldsmith's weights to the same test in different parts of the country, I did those of capacity, and found that two weights of the same denomination in different shops were seldom uniform. The scales used by goldsmiths are called *Kantah*, and are of metal; those used by dealers generally are called *Tajwa* or *Tagree*, and are made of leather or parchment.

Itinerary and Long Measures.—Distances between places are *estimated* by the *Kohs* (coss), I cannot say *measured*, for I believe the actual determination of distances between places was as little attended to by the native governments, as the facilitating communications through the country by the construction of roads and bridges. I *think* the *Kohs* averages about two miles English, varying, however, from 1½ to 2½ miles. In Mahratta writings long measure is raised from the barleycorn: 8 *Juw* or barleycorns make a *Boht* or finger, 24 fingers a *Haht* or cubit, (18 inches), 4 cubits a *Dunoosh* (a bow) or fathom, measured by a man's outspread arms, and 8000 cubits or 2000 fathoms a *Kohs*. The *Kohs* therefore would equal 2¼ English miles and 40 yards. In Sanscrit 2 *Kohs* make a *Guwyotee*, and 2 of the latter make a *Yojun* or 9 miles and 160 yards; but these terms are unknown to the common people. In fact, however, the measure of length originates in the well-known *Haht* or cubit, determined by the *mean length* of five men's arms, measured from the elbow-joint to the end of the middle finger: the *Haht* or cubit so determined, is a little more than 18 inches in length; this is divided into 2 *Weets* or spans, into 6 *Mooshtees* or fists, and each fist into 4 *Bohts* or fingers, and the latter into 8 barleycorns each. Tailors and sellers of cloth use a *Guj*, which is divided into 16 *Ghirra*, each of 1½ *Tussoo*, each *Tussoo* of 2 *Bohts*, and as each *Boht* is equal to a fraction more than ¾ of an inch, the *Guj* would be a little more than an English yard.

Superficial Measure.—The only land measure of any exact and appreciable extent is the Beegah, which is of Moosulman derivation, but by some referred to the Sanscrit word *Weegruhuh*, although this word is not applied to land measurements; and as all genuine Mahratta terms

* Waal is the seed of the Cæsalpinia sappan.

applied to the capacity, extent, or capabilities of land, are not referrible to the Beegah or its multiples, I must consider the Beegah of Moosulman introduction. Like itinerary measures, it is raised from the *Haht* or cubit of a fraction more than 18 inches in length; 5 *Hahts* and 5 *Mooshtees* (fists or palms) make 1 *Kattee* or stick, 20 square *Kattees* or sticks make 1 *Paand*, and 20 *Paands* a *Beegah;* reduced to English measurements, the 5 *Hahts* and 5 *Mooshtees* will be equal to 105 inches in length, and the square of this sum will be 11,025 inches in a square *Kattee* or stick, and 20 *Kattees* a *Paand* equal to 220,500 inches, and 20 *Paands* a Beegah or 4,410,000 square inches; and as the English statute acre contains 43,560 square feet, the Beegah is to the acre as $70\frac{1}{3}$ is to 100, or as 211 to 300, being a trifle more than seven-tenths of an acre. But as the *Haht* or cubit is a fraction more than 18 inches, the Beegah may fairly be considered equal to three-fourths of an acre: but I very much doubt whether any other than garden lands were actually measured by the Moosulmans; and in converting the Hindoo terms *Kundee*, *Mun*, *Doree*, and fifty other denominations, into Beegahs, it was done by *estimate*; and this explanation will account for the variable size of the Beegah in different parts of the country, which the British survey has discovered. The only multiples of the Beegah, to my knowledge, are the *Rookeh* of 6 Beegahs or $4\frac{1}{2}$ acres, and the *Chahoor* of 120 Beegahs or 90 acres: these terms are of Moosulman origin.

Adverting to the past and present state of the knowledge of native governments in politics, political economy and science, it would be idle to refer the origin of their weights and measures to scientific principles, immutable standards, or even to any uniform, although arbitrary system. Their long measure is derived from the human arm, and their weights from a seed. In these derivations they have not been a whit more irrational than the good people of England, whose standard measure of length, the *Ulna* or *Ell*, is derived from the arm of one of their kings, (Henry the First), and their weights from grains of wheat. There is a great coincidence between the native weights and measures and those of antiquity. The first five subdivisions of the scripture measures of length are identical in their derivation, and nearly so in their length, with those of Dukhun; namely, the finger, fist or palm, span, *Haht* or cubit, and fathom; both also have the coincidence of being destitute of a measure equivalent to a foot. The foot was a constituent of the ancient Greek and Roman measures; but in *practice* these nations used the finger, palm, and cubit; and the *Pecus* or great cubit of the Greeks was precisely of the length of the Dukhun cubit, namely, a fraction more than 18 inches.

The ancient grain and liquid measures of England were raised from weight from a pound troy. For a very long period I had believed the measures of capacity in Dukhun to be entirely arbitrary: but in the southern part of the country between the Seena and the Beema rivers, I met with *Adholees* with *stamps* on them, directing that they should contain a *certain weight* of grain: for instance, at Punderpoor the *Adholee* was to contain as much *Johr Guhoon* (wheat), as would weigh 200 Ankoosee rupees, at Mohol 160 rupees' weight of Joaree (*Andropogon Sorghum*), at Taimbournee 131 rupees' weight of Joaree, and at Kothool, near to Ahmednuggur, 200 Ankoosee rupees' weight of Bajree (*Panicum spicatum*). I know not whether this slight indication of systematic deduction of measures of capacity from those of weight is attributable to the Moosulmans or to the Hindoos. The places where they were met with, with one exception, had until recently, been for ages under a Moosulman government (the Nizam's), but it might have been practised before the arrival of the Moosulmans. It does not appear to have occurred to the natives to use the weight of water, as the least changeable standard by which to fix the capacity of a measure.

Army.—The army consists of some of the royal troops paid by the India Company; of European regiments of artillery and infantry belonging to the Company, and of native regiments of cavalry, infantry, and pioneers, armed, clothed and disciplined in the same manner as the European troops. The army is separated into divisions commanded by General Officers and Brigadiers-General, and the divisions are divided into brigades, which are so stationed as to co-operate in the readiest and most efficient manner in emergencies, for the protection of the country and the maintenance of the civil power.

Justice.—Not having been able to get blank forms filled up at the India-House with the necessary data respecting crimes and punishments, I abstain from any notice of judicial matters.—*Report of the Seventh Meeting of the British Association for the advancement of Science.*

X.—Literary and Scientific Intelligence.

Our meteorological correspondents will be glad to learn that their observations are valued and will be turned to account by Sir John Herschel, who thus writes to us from Hanover, under date 24th July 1838.

" When I left the Cape, I desisted from the further prosecution of the solsticial and equinoxial observations, but my best thanks are due to all those gentlemen who have supplied me with corresponding observations, and it will be one of my first objects, so soon as I shall be returned to England and in possession of *a fixed residence*, as well as of all my papers, and of some degree of leisure, to enter upon the task of their arrangement and reduction—to do justice, in so far as in me lies, to the great zeal and ability manifested in the communications of the observations which have reached me from various quarters.

" I regret to say, however, that the stations at which these observations have been made have neither been sufficiently numerous, nor (except in some few cases) the observations at each sufficiently continuous, to enable me to draw any *general* conclusions from them. Beyond the latitudes +40 and — 40, indeed, as I have already taken occasion to state in a circular addressed to all my meteorological correspondents, the *epochs* themselves are not sufficiently numerous; and to be of service the observations would require to be prosecuted monthly instead of quarterly, and pursued for many successive years, in stations systematically distributed.

" In India, where the meteorology is more simple and determinate, even a single year's series, is capable of affording interesting information, and I shall therefore be very glad to see the observations to which you allude, as being made at three stations* in Southern India. In all cases I would recommend that such observations should be published in the scientific Journals most accessible at the points where they are made. The transmission of MSS. is hazardous and circuitous, and there is a great advantage in placing the data on which theories are to be grounded as early and extensively as possible before *the public*."

* Madras—Trevandrum—and Hoonsoor. We regret that we have not received them from the latter station since March 1838.—Editor.

The Reverend William Taylor, Collator and Examiner of the Mackenzie MSS. has sent in his 5th report, the 6th and 7th being under preparation. He concluded his labours in January last, which have been carried on with industry and ability highly creditable to him. He has furnished five magnificent folio volumes of restored manuscripts, indicated in the course of his reports; each of them consisting of between 7 and 800 pages, which are really beautiful specimens of native caligraphy, in various languages, on the best English paper, and handsomely and substantially bound in green Morocco leather. The style of getting these volumes up, is entirely the spontaneous offspring of Mr. Taylor's liberal mode of executing his task, which pledged him to nothing but a simple transcript of the injured MSS. We hope to be able to introduce at a future period a more elaborate notice of Mr. Taylor's labours: with some critical examination into the intrinsic value of these far-famed and costly (though, we believe, much over-rated), oriental manuscripts.

XI.—*Horary Meteorological Observations made agreeably with the suggestions of Sir* John Herschel.

1st.—*At the Madras Observatory.—By* T. G. Taylor, Esq. *H. E. I. C. Astronomer.*

1839	Time.	Barometer.	Thermometer. Dry.	Thermometer. Wet.	Wind.	Remarks.
		In.	°	°		
Mar. 21	6 A. M.	30.054	82.0	77.6	N. W.	Gentle wind, thick haze.
	7 ,,	.078	80.4	77.5	W.	do. do.
	8 ,,	.100	82.3	78.1	N. W.	do. do.
	9 ,,	.116	83.4	78.5	do.	do. breeze, flyg. clds.
	10 ,,	.100	84.7	76.8	do.	do. do.
	11 ,,	.068	86.3	78 0	S. E.	Moderate wind, flyg. clds.
	12 ,,	.034	87.8	76.4	S. E.	do. flyg. clds.
	1 P.M.	.004	88.0	77.5	S. E.	do. do.
	2 ,,	.000	87.9	77.9	S. E.	Strong wind, clear.
	3 ,,	29.984	87.7	79.0	E. by S.	do. do.
	4 ,,	.966	87.8	78.9	E. N. E.	do. do.
	5 ,,	.960	86.0	77.5	E. N. E.	do. do.
	6 ,,	974	84.2	77.4	N. E.	do. do.
	7 ,,	30.002	83.6	77.0	S. E.	do. haze.
	8 ,,	.036	83.0	77.0	S. E.	do. cloudy lightning to the west.
	9 ,,	.028	82.8	77.0	E.	do. do. do do.
	10 ,,	.050	82.8	77.0	E.	Gentle wind do. do.
	11 ,,	.038	82.0	77.0	S. E. E.	do. clear.
	12 ,,	.026	81.5	76.7	E.	do. flyg. clouds
	1 A. M.	.002	81.8	77.5	——	Calm, cloudy.
	2 ,,	.002	80.5	76.5	——	do. do.
	3 ,,	.000	79.8	76.2	N. W.	Gentle wind—clear.
	4 ,,	29.980	79 8	75 5	W.	do. do.
	5 ,,	.960	79.6	75.2	W.	do. do.
	6 ,,	.976	76.7	74.6	W.	do. do.
	7 ,,	30.002	77.5	75.7	——	Calm do.
	8 ,,	.040	81.3	77.1	S. W.	Gentle wind, do.
	9 ,,	.054	83.5	77.3	W.	do. flyg. clouds
	10 ,,	.066	85.0	76.9	N. E.	Breeze do.
	11 ,,	.054	86.7	77.6	E.	Gentle wind, do.
	12 ,,	.032	87.6	77.1	E.	Strong wind, clear.
	1 P. M.	.000	88.3	75.9	E.	Moderate wind, do.
	2 ,,	29.985	89.0	74.5	E.	do. do.
	3 ,,	.964	88.0	76.5	S. E. by E.	do. do.
	4 ,,	.950	86.5	77.5	do.	do. do.
	5 ,,	.952	85 5	77.0	do.	do. do.
	6 ,,	.954	84.0	76.5	do.	do. do.

2*d.*—*Horary Meteorological Observations made at the Vernal Equinox* 1839, *at the Trevandrum Observatory.*—*By* G. Sperschneider, *Superintendent.*

Date.	Hour.	Newman's Standard bar. corrected for temp. 32° and for capillarity.	Standard ther.	Depress of wet bulb thermometer.	Temp. of dew point.	Direction of wind.	Velocity of the wind.	Solar radiation.	Clouds, aspect of the sky, and remarks.
March 21	6 A. M.	29.725	73.8	3.7	68.22	S E by E	3		Sky covered with thick haze—gentle wind.
	7	.747	75.8	3.2	71.15	do	,,	0.8	Light clouds in the zen. cum. in the N. E. horizon calm.
	8	.756	79.6	5.8	71.21	do	,,	2.0	Zen. clear cum. stratas in do. do.
	9	.752	83.7	9.6	69.76	do	,,	1.5	do. do. do.
	10	.771	88.0	12.9	69.33	S W	3	5.5	do. do. gentle wind.
	11	.758	90.3	14.2	69.95	do	3	6·0	do. do. do.
	Noon.	.727	90.0	12.9	71.79	do	10	10.0	do. do. pleasant B. gale
	1 P. M.	.700	90.0	14.3	69.38	do	10	6.3	do. cum. about hor. thunder on the E. do.
	2	.673	89.8	11.4	68.96	S S W	6	11.3	do. do. pleasant wind
	3	.650	89.2	13.6	69.61	S W	6	11.3	do. do. do. decreasing
	4	.636	88.0	12.7	69.68	do	4	2.3	do. do. gentle wind.
	5	.656	86.5	10.9	70.92	do	2	1.0	Zen. rather clear, rest cloudy—wind just perceptible.
	6	.683	84.7	9.6	70.94	do	2		do. thick cum. about hor. do.
	7	.705	84.2	8.6	71.98	do	2		Sky very cloudy, lightning continued,—halo round the moon.
	8	.735	83.7	7.6	72.99	do	,,		do. drizzling calm.
	9	.738	83.7	7.8	72.67	S W	1		do. do. light air.
	10	.749	82.8	6.9	73.07	do	,,		do. calm.
	11	.745	80.8	5.1	73.62	do	,,		Sky becoming clear sheet lightning in the S. S. E. calm.
	Mid.	.734	79.4	4.6	72.86	N N E	1		Zenith pretty clear, cum. about horizon, nearly calm.
,, 22	1 A. M.	.692	79.4	3.8	74.06	do	,,	No observation.	Sky in general clear, sheet lightning in the S. calm.
	2	.682	79.2	3.9	73.70	do	,,		do do. continued do.
	3	.682	78.2	3.4	73.38	do	,,		Sky getting cloudy do.
	4	.676	77.4	3.1	72.99	N E by E	1		Sky rather clear do.
	5	.695	76.0	2.2	72.86	do	,,		Overcast and threatening do.
	6	.702	76.5	2.4	73.08	do	,,		Zen. rather clear rest cloudy do.
	7	.733	77.8	3.2	73.26	do	,,	3.0	do. do do.
	8	.733	81.5	5.4	73.92	do	,,	,,	do. do. do.
	9	.752	84.1	7.1	74.19	do	,,	,,	Sky very cloudy do. do.
	10	.774	86.5	10.4	71.74	N by E	,,	2.0	do light air.
	11	.753	87.6	10.5	72.86	N W by W	3	5.2	Cirrous dispersed gentle wind.
	Noon.	.724	88.9	12.2	71.63	W	3	,,	Cloudy do.
	1 P. M.	.691	89.1	12.5	71.37	W S W	6	3.8	do. pleasant wind.
	2	.673	87.6	10.5	72.86	S W	6	5.3	Zen. clear, rest becoming cldy. do.
	3	.650	88.3	11.9	71.41	do	3	4.3	do. gentle wind.
	4	.637	86.8	10.4	72.09	do	6	4.0	do. do. at 4h 30m thunder in the N. E. pleasant wind.
	5	.651	84.8	8.9	72.18	do	3	,,	Sky covered with thick clouds, and threatening, gentle wind.
	6	.676	84.0	8.9	71.26	do	3	,,	do. do. do.

METEOROLOGICAL REGISTER KEPT AT THE MADRAS OBSERVATORY, FOR THE MONTH OF JANUARY, 1839.

Days.	Barometer at 10 A. M.	Barometer at 4 P. M.	Barometer at 10 P. M.	Ther. at 10 A. M.	Ther. at 4 P. M.	Ther. at 10 P. M.	Wet Bulb. 10 A. M.	Wet Bulb. 4 P. M.	Wet Bulb. 10 P. M.	Rain Sun-rise.	Rain Sun-set.	Evaporation.	Direction of Wind. 10 A. M.	Direction of Wind. 4 P. M.	Direction of Wind. 10 P. M.	Weather. 10 A. M.	Weather. 4 P. M.	Weather. 10 P. M.	Remarks.
1839	Inch.	Inch.	Inch.	o	o	o	o	o	o										
Jan. 1	30,126	30,036	30,086	78,2	78,6	78,2	4,7	5.6	5,2	......	......	......	N	N E	N E	Clear	Fl. cl.	Fl. cl.	
2	,100	,032	,082	77,7	79,6	76,2	5,3	5,9	5,3	......	......	1.794	E	S E	E	Clear	Fl. cl.	Fl. cl.	
3	,108	,038	,122	76,9	78,8	76,0	7,7	6,8	5,7	......	......	......	N E	E	E	Fl. cl.	Fl. cl.	Fl. cl.	
4	,124	,054	,130	76,8	80,0	76,7	4,4	7,0	5,0	......	......	......	N	N E	N E	Fl. cl.	Fl. cl.	Clear	Dew.
5	,142	,058	,108	78,9	80,5	76,3	6,0	7,0	4,5	......	......	......	E S E	E N E	N E	Clear	Clear	Clear	Dew.
6	,120	—	,092	77,8	—	76,0	4,8	—	4,9	......	......	......	N	—	N	Fl. cl.	—	Fl. cl.	Dew.
7	,127	,040	,090	76,5	79,7	76,5	4,5	8,2	5,1	......	......	......	N	N E	N E	Fl. cl.	Clear	Fl. cl.	—
8	,126	,044	,110	77,4	79,4	76,9	5,0	7,9	7,0	......	......	......	N N E	N N E	N E	Fl. cl.	Fl. cl.	Fl. cl.	Dew.
9	,114	,014	,078	77,0	79,0	76,7	5,0	7,5	5,2	......	......	2,114	N E	N E	N E	Th. hz.	Th. hz.	Fl. cl.	—
10	,078	,004	,082	77,2	80,0	76,6	5,9	8,3	6,6	......	......	......	E	E	E	Fl. cl.	Clear	Clear	Dew.
11	,106	,006	,068	76,7	80,0	77,7	5,8	8.8	6,7	......	......	......	E	E	E	Haze	Clear	Fl. cl.	—
12	,074	29,950	,022	76,8	80,5	75,7	6,5	8.8	5,4	......	......	......	N W	E	S E	Clear	Clear	Clear	Dew.
13	,056	—	,044	77,7	—	77.6	5,7	—	5,7	......	......	......	S	—	S E	Fl. cl.	—	Clear	Dew.
14	,100	30,010	,082	77,7	81,0	78,3	8,4	6,0	3,6	......	......	......	N E	E	S E	Fl. cl.	Clear	Fl. cl.	Dew.
15	,126	,018	,094	80,2	81,8	78,7	3,7	5,8	3,3	0,087	......	......	E S E	E S E	S E	Fl. cl.	Fl. cl.	Fl. cl.	Dew.
16	,110	,016	,056	80,5	82.8	79,5	3,7	5,8	3,4	......	......	1,896	S E	S S E	S E	Fl. cl.	Clear	Clear	Dew.
17	,096	,018	,072	80,9	82,8	80,0	3,8	5,8	3,7	......	......	......	S	S S E	S E	Fl. cl.	Clear	Fl. cl.	Dew.
18	,106	,020	,042	80.7	83,0	79,7	3,3	5,5	4,9	......	......	......	S	S E E	S E	Fl. cl.	Clear	Clear.	Dew.
19	,082	29,996	,032	80,6	82,5	79,7	4,1	6,0	3,7	......	......	......	S W	S	S	Clo	Clear	Clear.	Dew.
20	,055	—	,042	81,0	—	80,0	4,5	—	2,8	0,047	......	......	S	—	S SE	Fl. cl.	—	Clo. in the ho.	
21	,056	29,990	,038	81,7	83,0	80,1	4,4	5,3	3,2	......	......	......	S	S S E	S S E	Fl. cl.	Clear	Fl. cl.	
22	,100	30,000	,066	81,2	83,0	81,7	3,7	5,0	4,2	......	......	......	S E by S	S	S E	Fl. cl	Clear	Fl. cl.	Lightning.
23	,100	,002	,072	81,9	83,0	79,7	6,4	6,5	4,8	......	......	2,134	S E	S E	E S E	Fl. cl.	Clear	Fl. cl.	Do.
24	,152	,108	,172	81,8	80,8	78,8	5,2	4,8	4,6	......	......	......	E	E	E	Fl. cl.	Clo.	Rain	Do.
25	,194	,088	,148	79,4	80,8	78,7	5,4	6,6	3,6	2,981	......	......	N E	N E	N E	Clo.	Clear	Fl. cl.	Do.
26	,172	,068	,144	79,7	80,0	77,7	5,1	7,2	6,2	0,227	......	......	N E	E N E	N E	Clear	Clo.	Fl. cl.	Dew.
27	,178	—	,186	78.3	—	77,6	6,8	—	7,5	......	......	......	[illegible]	—	N E	Fl. cl.	—	Fl. cl.	Do.
28	,206	,126	,208	78,8	79,8	78,1	6,8	8,1	5,2	......	......	......	N. E	N E	N E	Fl. cl.	Fl. cl.	Fl. cl.	Do.
29	,224	,144	,202	79,3	80,8	78,5	6,8	7,9	6.9	......	......	....	N N E	E N E	N E	Fl. cl.	Fl. cl.	Fl. cl.	Do.
30	,224	,106	,200	80,0	81,0	78,6	6,1	7,5	4,5	......	......	2,324	E N E	E N E	N E	Fl. cl.	Clo.	Fl. cl.	—
31	,196	,094	,142	80,5	81,9	78,2	5,9	6,9	5,7	......	......	......	E N E	E	E	Fl. cl.	Fl. cl.	Fl. cl.	—
Mean	30,125	30,040	30,100	79,0	80,9	78,0	5,3	6,8	5,0										

METEOROLOGICAL REGISTER KEPT AT THE MADRAS OBSERVATORY, FOR THE MONTH OF FEBRUARY 1839.

Days.	Barometer at 10 A. M.	Barometer at 4 P. M.	Barometer at 10 P. M.	Ther. at 10 A. M.	Ther. at 4 P. M.	Ther. at 10 P. M.	Wet Bulb. 10 A. M.	Wet Bulb. 4 P. M.	Wet Bulb. 10 P. M.	Rain. Sun-rise.	Rain. Sun-set.	Evaporation.	Direction of wind. 10 A. M.	Direction of wind. 4 P. M.	Direction of wind. 10 P. M.	Weather. 10 A. M.	Weather. 4 P. M.	Weather. 10 P. M.	Remarks.
1839	Inch.	Inch.	Inch.	o	o	o	o	o	o										
Feb. 1	30,160	30,072	30.136	78,8	80,0	78,2	6,0	7,5	6,1	......	......	......	E. N E	N E	N E	Fl. cl.	Cloudy	Fl. cl	Dew.
2	,141	,068	,131	78,0	80,0	77,6	5,4	7,8	6,6	......	......	......	E	E. N E	N E	Fl. cl.	Fl. cl.	Fl. cl.	Do.
3	,156	—	,128	79,2	—	78,1	7,1	—	7,1	......	......	......	E	——	N E	Fl. cl.	——	Haze	Do.
4	,126	,050	,092	79,7	80.6	78,2	7.1	7,1	5,8	......	......	......	E	E	E	Clear	Clear	Clear	Do.
5	,112	,030	,100	78,3	80.5	78,0	4.7	7.5	4.5	......	......	......	N E	E	N E	Fl. cl.	Th. hz.	Fl. cl.	——
6	,128	,042	,132	79,7	81.5	79,8	6,2	7,5	5,3	......	......	2,283	N. N E	E	E	Haze	Haze	Fl. cl.	——
7	,158	,070	,150	79.1	79,7	79,2	4,0	5,7	5,9	......	......	......	N E	N E	E	Fl. cl.	Cloudy	Fl. cl.	——
8	,150	,062	,140	79.0	80,0	78,2	5,5	6,0	5,1	......	......	......	E	E. N E	E	Fl. cl.	Fl. cl.	Fl. cl.	Dew.
9	,102	,012	,062	79,7	80,8	80,0	5,2	5,8	5.1	......	......	......	E	E	E	Fl. cl.	Clear	Cloudy	——
10	,102	,016	,082	81,1	82,8	79,7	5,6	7,8	4,3	......	......	......	S	E	E	Fl. cl.	Clear	Clear	Dew.
11	,084	,014	,082	80,8	82.2	78,4	5.3	7,2	4,9	......	......	......	S E	E	E	Fl. cl.	Clear	Clear	Heavy dew.
12	,084	29,992	,024	79,2	82,0	76,3	3,7	7,0	4,9	......	......	......	S W	E	E	Fl. cl.	Clear	Clear	Do. do.
13	,028	,958	29,982	79,0	82,0	77,3	5,0	6,0	3,1	......	......	2,108	S	S E	S W	Clear	Clear	Clear	Do. do.
14	,010	,954	30.012	79,4	82,5	77,8	5,4	5,5	4.5	......	......	......	S W	S E. E	S	Clear	Clear	Clear	Do. do.
15	,046	,955	29,975	79,1	83,0	78,1	5,9	8.0	4.6	......	......	......	S	S E	S E	Clear	Clear	Clear	Do. do. *along shore,*
16	,014	.942	.994	80,5	83,8	79,1	5,5	7.8	2,0	......	......	......	S E	S E	S E	Clear	Clear	Clear	Do. do. [wind com-
17	,020	,916	30,000	82.5	85,2	80,1	6,5	8,7	2,6	......	......	......	S W	S	S E	Clear	Clear	Clear	[mences.
18	,070	,938	,082	83.5	84,4	80,9	6,5	6,4	3,7	......	......	......	S E	S. S E	S E	Clear	Clear	Clear	Dew.
19	,110	30,020	,096	82,0	84,0	79,8	6,4	7.5	4,3	......	......	......	S. S E	S E	S E	Clear	Clear	Clear	Do.
20	,146	,054	,119	79,9	82,2	78,3	4,9	7,7	5,9	......	......	2,434	S E	S E	S	Fl. cl.	Haze	Clear	Do.
21	,172	,088	,134	80,0	83,0	76,7	8,9	10,0	5,0	......	......	......	E	S E	S	Clear	Clear	Clear	Do.
22	,178	,078	,159	80,0	82,0	78,1	7,6	9,3	6,0	......	......	......	E	E	E	Fl. cl.	Fl. cl.	Fl. cl.	Do.
23	,159	,054	,130	78,6	81,0	75,8	7,1	8,0	4,3	......	......	......	S E	E	E	Fl. cl.	Th. hz.	Clear	Heavy dew.
24	,150	—	,100	78,1	—	75,6	5,1	—	5,2	......	......	......	S W	——	E	Clear	——	Clear	Do. do.
25	,116	,022	,086	78,2	83,0	76,0	4.0	7,5	4,1	......	......	......	E	N E. E	E	Clear	Clear	Clear	Do.
26	,099	29,996	,039	77,7	82,2	79,1	4,8	6,6	4,8	......	......	......	W	E	E	Fl. cl.	Clear	Clear	Do:
27	,036	,954	,000	80,3	83,8	79,1	5,8	8,3	5,6	......	......	2,147	S	E. S E	E	Clear	Clear	Clear	
28	,072	,958	,054	80,0	83,6	80,1	5,9	8,1	5,1	......	......	......	S E	E. S E	E	Clear	Clear	Clear	
Mean	30,104	30.016	30,077	79,7	82,1	78,3	5,8	7,0	4,9										

METEOROLOGICAL REGISTER KEPT AT THE MADRAS OBSERVATORY, FOR THE MONTH OF MARCH, 1839.

Days.	Barometer at 10 A. M.	Barometer at 4 P. M.	Barometer at 10 P. M.	Ther. at 10 A. M.	Ther. at 4 P. M.	Ther. at 10 P. M.	Wet Bulb. 10 A. M.	Wet Bulb. 4 P. M.	Wet Bulb. 10 P. M.	Rain. Sun-rise.	Rain. Sun-set.	Evaporation.	Direction of Wind. 10 A. M.	Direction of Wind. 4 P. M.	Direction of Wind. 10 P. M.	Weather. 10 A. M.	Weather. 4 P. M.	Weather. 10 P. M.	Remarks.
1839	Inch.	Inch.	Inch.	o	o	o	o	o	o										
Mar. 1	30,108	29,984	30,082	81,8	84,0	80,2	7,3	9,0	6,5	......	......	......	SE	SE	E	Clear	Clear	Clear	Dew.
2	,098	30,000	,078	81,2	83,7	80,2	6,7	8,0	5,6	......	......	......	NW	E	E	Clear	Haze	Clear	Dew.
3	,124		,068	81,8	—	80,3	6,4	—	4,7	......	......	......	NE		E	Fl. cl.		Fl. cl.	Dew.
4	,118	30,004	,068	80,1	82,5	81,3	3,5	5,5	3,8	......	......	......	N	NE	E	Cloudy	Cloudy	Cloudy	
5	,106	29,990	,078	82,2	84,5	81,6	3,5	5,0	3,5	......	......	......	NE	E	NE	Cloudy	Cloudy	Fl. cl.	Few drops of rain.
6	,092	,982	,070	82,7	84,6	81,7	4,7	6,1	5,3	......	......	1,549	E	E. SE	E. NE	Fl. cl.	Fl. cl.	Clear	Dew.
7	,070	,958	,016	82,6	84,7	80,7	5,2	6,2	4,2	......	......	......	E	E. SE	SE	Fl. cl.	Clear	Clear	Dew.
8	,086	,970	,034	82,0	85,0	80,9	6,1	7,5	4,5	......	......	......	SE	S	SE	Fl. cl.	Clear	Haze	Dew.
9	,068	,950	,004	82,5	86,0	82,0	5,5	7,0	3,5	......	......	......	SW	S	S	Clear	Clear	Clear	Thick fog.
10	,032		29,952	83,4	—	81,8	5,4	—	4,6	......	......	......	SW		SE	Clear		Clear	Dew.
11	,012	,918	,972	83,6	87,4	82,4	7,0	9,1	7,3	......	......	......	SW	S. SE	SE	Clear	Clear	Clear	Dew.
12	,028	,934	30,000	84,1	87,0	82,1	7,5	9,0	3,4	......	......	......	SW	SE	S	Clear	Clear	Clear	Dew.
13	,054	,956	,038	84,3	86,0	82,0	6,8	8,1	5,1	......	......	2,701	SW	S. SE	S. SE	Clear	Clear	Fl. cl.	Dew.
14	,080	,974	,056	83,9	85,0	80,8	7,9	7,0	5,6	......	......	......	SW	SE	S	Clear	Clear	Clear	Dew.
15	,110	30,008	,100	83,3	84,2	80,3	7,3	6,2	5,0	......	......	......	SW	E. NE	SE	Clear	Clear	Clear	Dew.
16	,160	,050	,108	82,3	84,6	80,2	7,4	7,6	6,5	......	......	......	E	E. SE	SE	Fl. cl.	Clear	Clear	Dew.
17	,106		,070	82,7	—	81,4	7,1	—	5,0	......	......	......	SE		E	Clear		Fl. cl.	Dew.
18	,128	29,988	,074	83,2	85,8	82,5	7,8	5,8	4,1	......	......	......	SE	E. SE	SE	Clear	Fl. cl.	Clear	Lightning to the S. E.
19	,106	30,024	,070	85,2	85,0	84,0	5,7	5,0	4,5	......	......	......	E	SE	SE	Cloudy	Cloudy	Fl. cl.	Do. do.
20	,124	,020	,088	85,6	84,6	84,1	6,8	5,1	5,1	......	......	2,741	SE	E. NE	SE	Fl. cl.	Cloudy	Fl. cl.	Do. do.
21	,100	29,965	,050	84,7	87,8	82,8	7,9	8,9	5,8	......	......	......	NW	E. NE	E	Fl. cl.	Clear	Cloudy	Do.
22	,055	,950	,022	85,0	86,5	83,6	8,1	9,0	8,0	......	......	......	NE	SE by E	SE	Fl. cl.	Clear	Clear	Dew.
23	,068	,980	,062	84,3	86,5	83,7	7,1	8,2	6,1	......	......	......	S	SE	SE	Clear	Clear	Clear	Dew.
24	,092		,072	84,1	—	84,5	7,9	16,5	6,8	......	......	......	SW		SE	Clear		Clear	Dew.
25	,082	,962	,019	84,0	89,0	84,1	7,0	9,6	8,0	......	......	......	SW	E. SE	SE	Clear	Clear	Clear	Dew.
26	,032	,940	29,994	84,5	87,8	83,0	12,0	9,6	6,5	......	......	......	SW	S. SE	SE	Clear	Clear	Clear	Dew.
27	,020	,918	,972	81,1	86,0	78,2	9,1	8,0	5,8	......	......	3,288	SW	S. SE	SW	Clear	Clear	Clear	Dew.
28	29,992	,914	,988	82,8	87,0	82,2	10,2	7,5	4,2	......	......	......	SW	S. SE	SW	Clear	Clear	Clear	Dew.
29	,991	,910	,968	84,0	86,5	82,2	7,5	7,5	3,2	......	......	......	S	S. SE	S	Clear	Clear	Clear	Dew.
30	[illegible]78	,894	,950	83,8	87,0	82,1	8,7	7,8	3,9	......	......	......	SW	S	SE	Clear	Clear	Clear	
31	[illegible]12		30,000	84,0	—	82,2	7,8	—	4,6	......	......	......	SW		S. SE	Clear		Clear	
Mean	30,072	29,967	30,036	83,3	85,7	81,9	7,1	7,8	5,2										

The Instruments with which the foregoing observations are made, are placed in the Western Verandah of the Honourable Company's Observatory: are about 5 feet above the surface of the ground, and 27 feet above the level of the Sea.

The barometer employed is No. 1, one of two Standards which I had constructed at the end of the year 1836, to supply the place of those broken during the storm: the indications set down are those immediately read off from the instrument, and consequently require in addition to the ordinary correction for temperature, the correction +,051 for capillarity: from a late comparison of these with a magnificent standard by Newman which had been constructed with all the advantages of modern improvement for the Trevandrum Obsesvatory, it appeared that when *corrected for capillarity*, the

Trevandrum Standard stood at		30,000	inches.
the Madras	No. 1	30,001	do.
	No. 2	29,993	do.

The thermometer was made on purpose for the Observatory, and at 72° (the only point at which a comparison has been made) it was found to differ insensibly from the Royal Society's Standard:

	h.	*m.*	*s.*
Longitude	5	21	8 E.
Latitude	13°	4′	8″,5 N.

T. G. TAYLOR,
H. C. Astronomer.